GGP Newsletter #5 - 10 September 1997

Contents

Prepared by David Crossley and Jacques Hinderer, September, 1997.

The First GGP Workshop - Minutes

The Workshop was held on 21 July 1997 at the Planetarium, near the famous Atomium in the north part of Brussels, Belgium.

Introduction - Crossley

The Chairman and Secretary welcomed all 40 participants to the workshop. Those in attendance were:

M. Amalvict (IPG Strasbourg, France), K. Aldridge (York U., Canada), T. Baker (Proudman Oceanographic Lab., UK), D. Banka, (Technical U. Clausthal, Germany), P. Baldi (Bologna U., Italy), J. Boy (IPG Strasbourg, France), D. Crossley (Saint Louis U., USA), G. Casula (Istituto Nazionale Geofisica, Italy), H.-F. Dittfeld (GFZ Potsdam, Germany), B. Ducarme (ORB Brussels, Belgium), N. d'Oreye (ECGS), M. Feissel (IERS, Paris, France), O. Francis (ORB, Brussels, Belgium), G. Harnisch (IFAG Potsdam, Germany) M. Harnisch (IFAG, Potsdam, Germany), J. Hinderer (EOST Strasbourg, France), H.-T. Hsu (Institute of Geology and Geophysics, China), Y. Imanishi (ORI, U. of Tokyo, Japan), O. Jensen (McGill U./CSGI, Canada), G. Jentzsch (U. of Jena, Germany) J. Kääriäinen (Geodetic Institute, Finland), C. Kroner (FSU Jena, Germany), L. Mansinha (U. of Western Ontario, Canada), B. Meurers (U. of Vienna, Austria), J. Neumeyer (GFZ Potsdam, Germany), M. Ooe (National Astronomical Observatory, Japan), S. Pagiatakis (NRCan, Geodetic Survey, Canada), B. Richter (IFAG, Germany), B. Rietschel (GFZ, Potsdam), T. Sato (NAO, Mizusawa, Japan), H.-P. Sun (Institute of Geology and Geophysics, China), S. Takemoto (Kyoto U.), Y. Tamura (NAO, Mizusawa, Japan), M. vanCamp (Royal Observatory of Belgium), T. vanDam (NOAA/NGS, USA) P. Vauterin (Royal Observatory of Belgium), H. Virtanen (Finnish Geodetic Institute), R. Warburton, GWR Instruments, USA), H-G. Wenzel (U. of Karlsruhe, Germany), W. Zürn (Black Forest Observatory, Germany)

Following an overview of the workshop events, the Chair recalled the responsibilities of the GGP member Groups.

Member Responsibilities

Each GGP Contributing Group agrees to:

Instrument and Site

(1) Maintain the integrity of the site and instrument. To ensure the continuity of the data stream over the 6 year Observing Period, the instrument should not be moved or turned off unless this is unavoidable due to technical problems or other factors.

(2) Maintain the instrument and the data acquisition system at the peak of its performance. Groups must ensure that all the supporting equipment an supplies are on hand in case of emergencies, that routine maintenance is performed and that interruptions are minimized due to careful planning and management of the facility.

(3) Calibrate the amplitude and phase characteristics of the instrument and the data acquisition system using GGP recommended procedures.

Data Reporting

(4) Send each month the agreed-upon data, as indicated below, to ICET within 1 year of the end of that month.

- (a) Provide the decimated, but otherwise unedited, files (code 00) to ICET. Where possible, groups should also send fixed files (code 02).

- (b) Provide auxiliary data, i.e. atmospheric pressure, rainfall and groundwater data to ICET, as well as a log file describing the main incidents that occurred at the site.

- (c) Send earthquake data to ICET, as requested by GGP through the Chair or Secretary.

Member Benefits

All GGP groups who send data to ICET will have access to the data from other GGP stations for a period of 1 year. After 2 years, ICET will release data for open use within 2 years of its collection, except for data from Syowa station in the Antarctic which is considered a special case within the GGP-Japan Network. The availability is summarized in the following schematic; note that the schedule moves forward on a monthly basis.

month		+1year		+2years	
	<Data sent to ICET>				
			<Data for GGP Groups>		<Data on Open File>

Discussion

On the availability of GGP data

Francis: people should send data as soon as possible in order for ICET to plan its work; it will not be helpful to ICET if all the data arrives at once from all the groups.

Feissel: what feedback will ICET give?

Ducarme: files from stations such as Cantley or Table Mountain could be tested and reports made available after data processing.

Feissel: a dialog between the data provider and data center, based on validation of the data, clearly improves delays in such a project.

Action

O. Francis to provide GGP members with an indication of what validation ICET will promise in response to various kinds of data.

The discussion continued on the availability of files with code 02 i.e. files that were repaired prior to decimation to 1 min.

Crossley: there is a manpower problem to edit data and to fix them, so we cannot expect all groups to undertake this task. If the code 00 data is sent, this will reduce delays due to the need for groups to do the data editing.

Francis: in response to a request from a GGP contributing group, ICET will provide yearly CD-ROM + access to the data by FTP.

Mathews: there is concern at the 2 year delay to make GGP data free to everybody.

Crossley: as in the past, any scientist may enter into private agreement with any GGP data provider for access to data. GGP deals only with access to the GGP data as a whole.

Feissel: what about credit for providing GGP data in the framework of the GGP network; should it be co-authorship in later publications or only acknowledgments?

Zürn: a good scientific paper obtained with GGP data is a reward in itself and will justify the network.

Feissel: there should be something written, such as a report bulletin, which could be published yearly in the BIM.

Zürn: the presence of a readme file on the CD-ROM would help a lot.

Concerning GGP Newsletters

Dittfeld: a questionnaire in a standardized form for every station would be nice.

Action

-A questionnaire is supplied to each group (attached to this newsletter). -Gunter and Martina Harnisch, Corinna Kroner to be placed on GGP mailing list -GGP Newsletters should be on the Web Page, but emailed LATEX versions will still be sent

Station Review

Due to the length of time involved, it was decided not to ask for a station review from each group, but to discuss only those stations that were in transition:

Bandung, Indonesia - the new installation is planned for occupation at the end of November 1997.

Thessaloniki, Greece - the status of this potential site is unknown. As far as we are aware, the instrument has been moth balled due to lack of funds for liquid helium. There was no funding from within GGP to help Arabelos resurrect the instrument.

Wuhan, China - the instrument will be ready to operate at a new, much quieter, site in about two months, i.e. September 1997.

Canberra, Australia - the instrument, SG model C031, has been in operation for some time.

On an poll by the Chair, there were 15 stations currently in operation and reporting to GGP.

Feissel: GGP should use ITRF conventions to express the coordinates of our stations; there was some debate as to what this is necessary.

GGP Files and File Names

The data filename format and data repair codes (00, 01, and 02), which are listed in Newsletter #2, are henceforth accepted without further change. For filtering the data recorded from the gravimeter, there are two steps:

1. Every station uses an analog filter which prevents aliasing of the sampled data. GWR has recently upgraded the old TIDE filter to a new version that follows more adequately the GGP specifications. The new filter is available from GWR - see the last two Newsletters and Warburton's contribution to his newsletter for details.

2. There is a digital decimation filter, typically from 1, 2 or 10 sec to 1 min, that is applied to either raw or fixed data before the data is sent to ICET.

Francis: ICET needs to check this digital filtering process for every station soon. To do so,

Action

Every group is required to send ICET 3 files: (a) a one month file of raw data, at the original sampling rate, in GGP format, (b) a file containing the decimation filter used to decimate raw data to one minute, and (c) a month file of 1 minute data in standard GGP format, code 00

Changes in the header:

A suggestion was made to reduce the number of decimals for some of the parameters such as station height; format f10.3 is sufficient.

Action

See the revised file specifications at the end of this Newsletter

Earthquake Data

Two choices have been discussed for earthquake data, to be exchanged quickly following a major seismic event:

1. A header + data in a structured format (discussed in Newsletter #2), and

2. Data in the PRETERNA convention, exactly as for the 1 minute GGP data.

After some discussion, the participants agreed on option 2; i.e. to keep the same data structure as for the 1 min samples. GGP still has to discuss the provision of this data in SEED format, or equivalent, for the seismic community.

Instrumental Considerations - Warburton

Warburton has provided the complete text of his presentation at the workshop. The figures will be provided on the Web version of the Newsletter and sent by regular mail to each GGP member.

The complete version of this text can now be found under Publications.

Gravity Card - Revision 2 Features

- New high precision reference oscillator
- High current transformer driver
- Improved low temperature dependence drive transformer
- Magnetic modulator input for measuring frequency response
- Electrostatic modulator input for measuring frequency response
- GGP low pass filter
- Improved layout with 4 layer PCB and shielded input stage
- On-board temperature sensors
- Improved components
- GWR5 Low Pass Filter

GGP1 & GGP2 Low Pass Filters

- GGP1 filter intended for 1 Hz sampling rate - (See Figure 1)
    - 8 pole Bessel filter
    - Corner frequency at 61.5 mHz (16.3 sec period)
    - Constant time delay of 8.2 seconds (Phase lag 0.034 deg/cpd)
    - 100 dB attenuation at 0.5 Hz (f_{nyq} for 1 Hz sampling)
    - Attenuation < 1% (-.086dB) below 0.01 Hz (100 sec period)
    - Attenuation < 4% (-.341dB) below 0.02 Hz (50 sec period).

GGP2 filter intended for 0.5 Hz sampling rate (optional)

- 8 pole Bessel filter
- Corner frequency at 30.8 mHz (32.6 sec period)
- Constant time delay of 16.4 seconds (Phase lag 0.068 deg/cpd)
- 100 dB attenuation at 0.25 Hz (f_{nyq} for 0.5 Hz sampling)
- Attenuation < 1% (-.086dB) below 0.005 Hz (200 sec period)
- Attenuation < 4% (-.341dB) below 0.01 Hz (100 sec period).

Characterizing Frequency Response

- Magnetic modulator
    - Adder allows injection of current into the feedback circuit, to measure closed loop response.
    - Jumper selection removes adder eliminating unnecessary components.
    - Jumper selection allows both open and closed loop characterization.
- Electrostatic modulator
    - Allows similar measurements by using electrostatic force
    - Response depends only on geometry of sphere & plates and is independent of magnetic levitation.
    - Allows measurement of charge.

General Noise Reduction on Gravity Card

- Improved oscillator - (See Figure 3)
  - Improved temperature stability
  - Reduced harmonic distortion
- Improved drive transformer - (See Figure 4)
  - Toroid design replaces bobbin design decreasing TC by order of magnitude.
- High current transformer driver
  - Lowers distortion and impedance of drive circuit
- 4 layer PCB, improved grounding and shielded input stage
  - Reduced cross-talk between drive and sense circuits - (See Figure 5)
  - Reduced overall broad band noise - (See Figure 6)
- On-board temperature sensors
  - Simplifies monitoring of electronics temperature
- Improved components
  - Hermetically sealed ultra stable passive components
  - Selected grade IC's for low noise, thermal drift, and long term stability
  - Conformal coating improves resistance to humidity and surface contamination

Decrease in Gravity Card Temperature Dependence

- Old gravity card had a temperature dependence between 0.1 to 1 mgal/°C. (See Figure 7)
- New gravity cards have temperature dependence less than 0.01 mgal / °C (See Figure 8)

GWR5 Low Pass Filter - (See Figure 2)

- Intended for future acquisition system capable of sampling at approximately 1 plc (50Hz or 60Hz). Data system should implement real-time digital filter decimating output to 1 Hz.
- 2 pole Bessel filter
- Corner frequency at 200 mHz (5 sec. period).

Temperature control

- **Check feedback characteristics**
  Uses should measure the response of gravity, temperature power and temperature balance to a change in temperature control null position. In Figure 9, an offset from ``off" to +000 (=0.21 reset) equals about .084 mK and produces a gravity offset of 1.25 mgal. When the feedback is working well, both the temperature power and balance should return to equilibrium with only 1 to 2 excursions.

- **Expected temperature balance noise (and what gravity noise level this corresponds to)**
  Temperature balance noise is about ± 0.05 mV => ± 1.5 mK => 15 ngal

- **What are the implications of spikes on heater power or temperature balance signals? Could these produce offsets in data?**
  Spikes in the temperature power or balance could indicate that an offset in temperature has produced an offset in gravity. In concept, one could measure an offset in power associated with the temperature offset. However, noise limits measurement of power offsets to 10 mV. Therefore, since the power sensitivity is only 0.4 mV/mgal, one can only resolve offsets larger than 25 mgal.

- **Can the spikes be recorded to indicate a problem?**
  Yes, one must correlate gravity offsets to power spikes to prove cause and effect. However, this requires at least a 2 second sampling interval since the power spikes are only 10-15 seconds wide.

Tilt control

- **Check feedback characteristics**
  Users should measure the response of tile power and tilt balance to a change in both X and Y reset. In Figure 10 the X Reset has been changed from +521 to +526 which corresponds to about 30 mradian. Check that both the power and balance return to equilibrium with only 1 or 2 oscillations.

- **Expected tilt balance noise**
  The tilt noise will depend on how quiet the user's site is. At GWR the tilt balance noise is about ± 10 mV which corresponds to a tilt noise of about ± 0.1 mradian. Users are encourage to measure the relationship between micrometer ``mils", tilt balance volts (BD=7), reset units and mradian. In the instrument tested at GWR: 1 mil = 2.9 V = 5.8 reset = 32 mradian. These relationships will depend on the length of the tilt arms, the electronic gain, and the tiltmeter sensitivity.

- **What are the implications of spikes on X or Y tilt power or balance signals? Could these produce offsets in data?**
  As with temperature, these spikes could indicate that changes in the tilt control position are producing offsets. However, such a conclusion cannot be reached without using secondary tiltmeters or by correlation of spikes with gravity offsets. The width of tilt balance spikes is 2 to 4 minutes and can easily be observed by sampling with a 20 second interval.

- **Tilt geometry & manual tilt desensitizing (FB & LR)**
  All compact Dewars and many other instruments now use equilateral leveling frames versus the older isosceles triangular frames. The geometry of the two systems is illustrated in Figure 11. The advantage of the isosceles support frames is that the left and right axes are orthogonal and that the two tiltmeters can be aligned with these axes. In SET-UP, this means that reading of the X (or Y) micrometer does not affect the null position measured with the other micrometer. With the equilateral frame, the user must simultaneously use both left and right micrometers to define two new tilt axes labeled Left-Right (LR) and Forward-Back (FB). LR is defined by moving both X and Y micrometers in the same direction, e.g.: DELTA X = +5 mils and DELTA Y = +5 mils; while FB is defined by moving in opposite directions, e.g.: DX = +5 mils and DY = -5 mils.

- **Tilt desensitizing in feedback using X or Y Resets**
  With the leveling platform operating in feedback (RUN), both equilateral and isosceles support frames can be tilt minimized in an orthogonal fashion using the Left (X) Reset and the Right (Y) Reset. The X & Y reset functions produce orthogonal tilts because they produce electronic offsets in the tiltmeters themselves. However, since the thermal levelers do not produce orthogonal tilts, they both must respond to either a X or Y Reset change. This is shown in Figure 12, where the X tilt axis is being tilt minimized using only the X-Reset. As shown, the X Power response is larger than the Y power. From the geometry of the equilateral frame and tiltmeter alignment, the ratio of the Y tilt power should be 0.27. In the example, the power ratio was 0.36 which is most likely due to errors in the electronic square root function in the feedback network and to different leveler response to heat.

- **Expected tilt noise close to minimum**
  The slope of the tilt curve Dg/(D Reset)^2 can be used to calculate the expected gravity noise produced by tilts. For example, in the data show, the gravity noise is about:

  $$Dg_N \ @\ 4.6 \times 10^{-4}\ (\text{mgal}/(\text{mrad})^2)(Q\text{-}Q_0)\ DQ \qquad (1)$$

  Therefore, the tilt noise depends on the tilt slope, how close the instrument is adjusted to the tilt null Q_0 and the noise level DQ at the site. In the example shown, if $(Q\text{-}Q_0 < 1$ Reset (=5mrad) and the noise DQ = 0.1mrad, then the tilt induced gravity noise Dg_N @ 2.5 ngal. At a site such as Membach, the tilt noise is about 5 times quieter than at GWR. Therefore, the tilt induced gravity noise will be Dg_N (Membach) @ 0.5 ngal

- **Need for an annual tilt check**
  GWR recommends that users perform annually tilt checks for both X-Reset and Y-Reset. When the system is operating properly, neither the X or Y Reset values will change in time. This means that the tilt minimum of the gravity meter and the null points of the tiltmeters have remained stationary with time.

Data Acquisition and Analysis

- **(Membach, Belgium data as an example)**

  - **Instrumental channels to record gravity and for SG maintenance**
    Data channels can be classified into three categories. Recording the main signals of gravity and air pressure is already fully discussed in previous GGP meetings. The auxiliary signals are used to check and monitor the subsystems of the gravimeter to make sure they are operating correctly. It is important to establish a baseline of operation on the subsystems for regular comparison to make sure performance does not degrade in time. This will be especially helpful when problems arise that must be discussed with GWR. Comparison of data with the system working correctly versus improper operating is essential for diagnosing failures rapidly. The geophysical signals are of prime importance for correlating with observed gravity changes. This correlation allows further reduction of secular or short term signals from the data. For example, groundwater will produce long term secular signals; while rain fall may produce 1 to 3 day spikes in the data. Finally, regular absolute gravity measurements allow either confirmation of long term trends in superconducting data or correction of instrumental drift.

  - **Main signals:**
    Gravity
    Air pressure

- **Temperature balance**
  Heater power
  X & Y Tilt balance
  X & Y Tilt power
  Electronics temperature
  Vault temperature
  Neck temperatures
  Helium flow
  (Compressor water coolant temperatures)
  (mode data?)
- **Geophysical signals:**
  Permanent GGP measurement of elevation changes
  Ground water variations
  Soil moisture
  Rain and snowfall
  Other??
- **Periodic Absolute Gravity measurements**

- **Notes of caution:**
  1) ***User's data systems should use differential and isolated inputs***. Each signal from the GEP-2 electronics has a corresponding return (common) which is referenced to a specific location on the board where the signal is generated. Connecting commons together at the data system will disrupt the electronic design and will produce ground currents and noise. It is for this reason that GJ1 through GJ4 and the front panel connector are isolated BNC connectors. The commons of these BNCs should not be grounded.
  2) ***Use caution on recording Heater Power***. We have observed that connecting a long cable to the heater power (GJ5 pins 7/15) can cause noise on the gravity signal. Pin 7 connects directly to the output of the temperature feedback integrator (U7). The increased capacitance to ground present in the cable connected to pin 7 may cause U7 to oscillate at a high frequency. This oscillation will shift the DC level of the output and produce a shift in the temperature control position. If this happens rapidly the result looks like noise. If it happens infrequently it will look like random offsets on the gravity meter. Users with short leads between GEP-2 and their data systems are probably safe from oscillations. However, for users with long leads we recommend that they discontinue recording the heater power by disconnecting pins 7/15 in the cable connected to GJ5.

- **Daily & weekly analysis of data**

  Daily - It is important to analyze and monitor the main and auxiliary signals frequently in order to minimize data interruptions and gaps. The best way to guarantee the highest quality gravity data is to generate a tidal residual signal by subtracting a tide model based on the analysis of previous data. Ideally this can be done on a daily basis as in the data shown in Figure 13 (air pressure, tidal residual, & theory from Membach). Once the residual is generated, the user can determine:
  1) Has the instrumental noise level remained low?
  2) Are there any offsets or spikes (besides earthquakes)?
  3) Are there any abrupt changes in slope or drift?
  4) Is the data system, timing and data storage working properly?

  Weekly - The same type of analysis can be done on a weekly basis as in the data shown in Figure 14 (air pressure, tidal residual & theory from Membach). This residual data should be compared to the X & Y Tilt balance and power (Figure 15), Heater power and temperature balance (Figure 16), electronics temperature, and vault temperature. For example on the X tilt power there is a large spike. However, by comparison of this event to the tidal residual one can determine that this event did not produce a corresponding spike or noise on the residual data. What caused this spike then? If it was a user entering the vault, it should cause a change in vault temperature or produce an entry into the log book.

  Clearly, the more often the tidal residual is generated and checked the shorter gaps in the data will be. However, weekly checks of the temperature, tiltmeters, and refrigeration systems are most likely adequate. Monitoring the neck thermometers to observe an increase in temperature is the most rapid way to determine when the cold head is beginning to age. This allows plenty of time to replace the cold head since they degrade slowly.

- **Is the Mode filter useful anymore?**
  Recording the mode bandpass filter on a strip chart recorder (See Figure 17) is a quick and simple way to examine the high frequency noise present on the gravity signal. Therefore, it may be useful for users who are not generating and examining daily tide residuals. However, it can only be used for checking for changes in instrumental noise and for offsets and spikes. It cannot be used for changes in drift (since DC signals are filtered out) or for operation of the data system or storage medium.

  The mode filter could be recorded as auxiliary data at 20 second intervals and be used to scan the data for offsets. As shown in Figure 17, a 40 mV step function into the mode filter produces a spike response of about 1.22 V (peak to peak). Therefore, the magnitude of offsets producing such spikes can be (practically) read of the mode filter data if the noise level is low. For high noise regions it is more difficult to remove such offsets. Possibly, the mode filter data would be useful to other GGP participants to quickly determine data quality before they commit to the process of ``cleaning'' the data for further analysis.

- **Importance of Absolute Gravity Measurements**
  Figure 18 shows the gravity residuals of the superconducting gravimeter (SG) compared to the measurements from the absolute gravimeter (AG) at Membach, Belgium. In this case there was a data gap and offset that occurred in the SG near the end of May-96. This offset was estimated and corrected by comparison of SG to AG data. From these data sets it appears that the SG at Membach has very little instrumental drift. Generally, however, some drift may be present on the SG at other sites. Such drifts are always monotonic and usually decrease in time. These drifts can be measured by comparison of the SG residual data to AG data if AG is taken at regular periodic intervals. The SG can also be used to check proper operation of the AG. As can be seen from the data, there are two AG data points at 18000 hours that disagree significantly with the rest of the data.

- **Importance of measuring other geophysical data**
  The agreement of SG and AG data markedly increases confidence in both data sets and proves that the observed gravity variations are of geophysical origin and not of instrumental origin. The geophysicist's job is now to identify the cause of such variations. One common method of doing this is by establishing a correlation between the gravity residual and other geophysical signals. However, this powerful technique can only be used if the geophysical signals have been recorded over the same time period as the gravity data itself! Therefore, users must establish a list of geophysical signals that are most likely to influence data at their sites and implement methods to measure and record them as soon as possible.

  Acknowledgment: The author sincerely thanks Olivier Francis and Marc Hendrickx for supplying the data from Membach, Station, Belgium which is used as examples in this section.

Discussion

There was discussion of the barometric measurements considering that the long-term stability and accuracy required by GGP is rarely matched by most of the available sensors.

Mansinha: raised the problem of the frequency response of the barometric sensors, with no definitive answer being given.

Wenzel: where should the barometer be installed? Again there was no definitive answer.

Dittfeld: a comparison between different barometers operating at the same station is needed.

Sato: with respect to the cold head clearance check, it is much more sensitive to do it by checking with an oscilloscope the signal on the gravity card than by using the stethoscope.

Richter: concerning the annual re-tilt, several changes were found in Wettzell, and even a second tilt minimum

Hinderer: no noticeable change (in tilt minimum) was found in Strasbourg for T005 (9 years)

Crossley: a lot of environmental parameters are needed (rain, soil moisture, permanent GPS, and groundwater) for some stations.

Calibration - Richter

There was a review of the possible ways to calibrate the SG:
- by parallel registration with AG measurements
- by some form of mass attraction

Casula: made a short presentation on calibration with a static mass that showed changes in the calibration values with time. This raised a lot of questions on the stability of the calibration.
- inertial platform (the most precise but strong perturbations to the SG)
- importance of testing the filter + feedback system by the step response method (or harmonic waves)

Data Repair - Crossley

Different perturbation examples were shown and GGP members were asked to answer what they would do in fixing the data. A hot discussion followed and obviously people are far from agreement on a standard way to proceed.

EARTHQUAKES: it was agreed that saturated signals has to be removed but not necessarily the main earthquake signal.
SPIKES: make a gap with no information or fill it with a local synthetic tide
STEPS: unclear and highly suggestive

Warburton: people should pay attention to other control signals occurring at the same time to decide if the step is instrumental or not.

Pagiatakis: steps should be treated as unknowns which should be solved for in a more comprehensive inversion of the gravity data. Although this was accepted in principle to be correct, most of the audience acknowledged the practical difficulties of doing this.

Jensen: data corrections, besides being somewhat subjective and time consuming, may be unscientific because original data is being modified. This was regarded as an extreme view.

Feissel: why is it considered necessary to send fixed data to ICET? The answer is that this reduces the amount of work that ICET has to do, and is in any case a by-product of a group's natural desire to clean up the problems in their own data.

Ocean Tidal Models - Francis

- a lot of new models derived from satellite altimetry (TOPEX-POSEIDON) are available.
- there is no best model everywhere (in the world)
- more generally, the old Schwiderski model of the 1980 is still competitive; among the new models, CSR3.0 (Texas University) and FES (Grenoble) are the best.
- for long period tides, Mf and Mm tidal models will soon be available; for the others, use either Schwiderski or equilibrium tides.
- the admittance function can be used to estimate the smaller tides which are not modeled.

Baker: showed a plot where the differences between CSR and FES are indicated; these are in general small except on the shelves.

Ooe: smaller size meshes are required in some regions

Atmospheric Corrections - Hinderer

- need for a more global atmospheric loading correction for long-period phenomena (the nature of the ocean response to air pressure changes is then important)
- need for a frequency-dependent admittance between local pressure and gravity
- contribution of stratified atmosphere versus surface loading under investigation
- availability of global atmospheric data? Agreement with ECMWF required and depending on the national weather centers if not, data sets have to be bought and the price is expensive.

Richter: IFAG paid indeed for such a set

Feissel: it is suggested to contact the new subsection of IERS on global fluid dynamics to see what can be provided via this service.

Review of the Japanese Stations - Sato

- there are 6 SG in a subnetwork of GGP
- one has been installed in Australia near Canberra
- one will be installed in Indonesia in Bandung next fall

A discussion ensued on some stations being able to operate in GGP for the planned 6 year long common observing period.

Jensen: mentioned the vulnerability of the North American stations (Cantley and Boulder) for evident budget restrictions

Van Dam: people who were favorable to SG measurements at NOAA have now moved away and gravity research is less well supported

Wenzel: would a resolution [presumably from GGP or IAG] be profitable to the community and especially for these vulnerable stations?

Neumeyer: GFZ is exploring the possibility of an SG site in South Africa at a quiet location, possibly at the beginning of next year.

Jentzsch: he will definitely be in charge of the former Asse Mine instrument but there is no guarantee that it might still be usable.

Warburton: Pinon Flat, one of the most venerable SG sites, is still available with suitable manpower.

The 1999 Solar Eclipse - Mansinha

There will be a solar eclipse in Europe on 11 August, 1999. The favorable geometry of the total eclipse path means that several SG or other gravimetric stations will be extremely well located to observe potential effects. These stations are: Brussels, Membach, Strasbourg, BFO, Vienna, and Wettzell.

- importance of this event to study theoretical problems in fundamental physics like gravitational absorption but also dynamical phenomena in the thermally-induced atmospheric pressure waves

- necessity of using microbarographs to study the small pressure perturbations (preferably with a network of well-located sensors)

- agreement between the European GGP members to have a coordinated project to perform this experiment in the best possible conditions. Mansinha asks for official endorsement by GGP.

Action

See the revised file specifications at the end of this Newsletter

GGP Data Center at ICET with GFZ Software - Rietschel/Francis

Rietschel reviewed the data center developed at GFZ Potsdam with special software based on the PERL language. This software is ideal for adaption to GGP and can be provided to ICET and installed in Brussels.

Aldridge: it is important to have a mirror site because of the transmission slowness which is often experienced on the net.

Francis: confidentiality will be ensured by passwords and ICET will monitor the appropriateness of all data requests.

Richter: who is giving support, maintenance and upgrade to this software?

Rietschel: there will be a collaboration between GFZ and ICET and training. Additionally GFZ is also willing to provide this software to any single GGP user.

Francis: the current method of using FTP for transferring files will be continued.

Action

The audience voted unanimously to accept the proposal by Rietschel, Francis and Neumeyer for installing the GFZ Data base software at ICET for GGP.

Next GGP Meeting

Two possibilities were suggested for the 1998 workshop:
- the **SEDI meeting in Tours**, France in the summer of 1998, and
- the **IAG General Assembly in Trieste**, Italy in September 1998, following an invitation by Iginio Marson (IAG)

After some discussion and a vote, it was decided to choose **Trieste.** The details of the GGP meeting will be arranged with I. Marson who is organizing the IAG meeting and transmitted later to the GGP members.

Update: Marson reports that the joint meeting of the International Gravity Commission and the International Commission for the Geoid will be held in Trieste from September 7 to 12, 1998. He is open to suggestions concerning the GGP meeting, but the preference of the GGP members would probably be to meet on 6 September, 1 day before the main meeting gets underway. Further details will be distributed in due course.

REMINDER: One person per Instrument Group should return the Station Questionnaire.

A questionnaire on station status will be distributed every 4 months to groups (July 1, November 1, and March 1).

GGP Station Questionnaire

To be completed by each group contributing data to GGP.
ONE FORM IS TO BE RETURNED PER INSTRUMENT
Please return completed questionnaire immediately to
David Crossley or Jacques Hinderer.

(Note that examples are NOT necessarily accurate)

Station	ID	
	Instrument	
	Location	
	Latitude (N)	

	Longitude (E)	
	Height (m)	
	StartOps	
	StartRecord	
Gravity	Sampling (s)	
	Recording (s)	
	Precision (mV)	
	Calibration (ugal/V)	
	FilterCornFreq (mHz)	
	NyquistCutOff (dB)	
	PhaseShift (deg/cpd)	
Pressure	Sampling (s)	
	Recording (s)	
	Precision mV	
	Calibration mbar/V	
Auxiliary	DataICET	
	AuxData1	
	AuxData2	
Contacts	Name	
	Institute	
	Email	
	Sender(s)	
	WebSite	
	Special Notes	

For a description of the fields to be completed (and stations already completed) see **All Stations**

Review of GGP File Formats

Most of this information has appeared in previous Newsletters.

Filename Convention

Station	Year	Month	Repair Code		File Extension	Content
CA	89	12	00	.	ggp	gravity / pressure
CA	89	12	00	.	aux	auxiliary data
CA	89	12	00	.	log	log file
CA	89	12	00	.	zip	compressed version of all files

Data Repair Codes

(a) No repair

Code	significance
00	raw data, decimated but untreated

(b) Repair done on raw data, before decimation to 1 min

Code	significance
01	gaps and disturbances filled with synthetic signal
02	as 01 + offsets adjusted

(c) Repair done on data after decimation to 1 min

Code	significance
11	gaps and disturbances filled with synthetic signal
12	as 11 + offsets adjusted

(c) One hour data, decimated from 1 min

Code	significance
h1	data processed by ICET
h2	data processed by user

1 minute Data

This is a slight modification of the table from Newsletter #4.

Line	Text (a20)	Parameter 1	Parameter 2
Line 1:	Filename	[name of file] (a20)	
Line 2:	Station	[name of station] (a20)	
Line 3:	Instrument	[name of instrument] (a20)	
Line 4:	Phase Lag (deg/cpd)	[phase lag] (f10.4)	[error] (f10.4)
Line 5:	N. Latitude (deg)	[latitude] (f10.4)	[error] (f10.4)
Line 6:	E. Longitude (deg)	[longitude] (f10.4)	[error] (f10.4)
Line 7:	Height (m)	[height] (f10.2)	[error] (f10.4)
Line 8:	Gravity Cal (ugal/V)	[g calibration] (f10.4)	[error] (f10.4)
Line 9:	Pressure Cal (mbar/V)	[p calibration] (f10.4)	[error] (f10.4)
Line10:	Author	[email address of author] (a40)	
Lines 11	*other information*		
C****	*end of header*		

top