Report of Activities of the IAG/ETC Working Group 5 «Global Gravity Monitoring Network (g-gramophone)»

Bernd Richter
Institut für Angewandte Geodäsie
Richard-Strauss-Allee 11
D-60598 FRANKFURT a.M., Germany
Richter@ifag.de

Objectives:

This working group has been a forum to tighten existing global gravity networks e.g. Network of Superconducting Gravimeters (GGP), the International Absolute Gravity Base station Network (IAGBN), which are observed with instruments at the highest technical level. Methods shall be discussed to complement the techniques mainly used for the observations. The idea shall be supported to intensify the combined observations of superconducting gravimeters with repeated absolute gravity measurements at stations which are suitable for such comparisons.
The combined data sets should be the base for studies of the performance of the instruments, the influence of environmental parameters on gravity from local up to global effects, the history respectively the long term stability of fundamental gravity base stations.
The results of these studies will support the knowledge of the variability of gravity stations in order to improve the overall error budget of gravity measurements and to increase the possibility to complement measurements performed with other techniques like space geodetic techniques to study local, regional and global height variations or mass redistributions.
Within the group, the information shall be exchanged by circular e-mails and faxes. Business meetings at major gravity conferences shall be used for direct communications and discussions. Besides the discussion of internal matters, results and ideas, interesting papers and articles touching the basic ideas of the working group shall be distributed. All information will be stored in an information board which can be the base of a comprehensive archive for precise gravity networks as well as a documentation of the state of the art for the used gravity techniques and models.

Members:

T. Baker, G. Casula, O. Francis, J. Hinderer, H. Hsu, J. Maekinen, I. Marson (president Gravity Commission), B. Meurers, T. Sato, T. van Dam, B. Richter (chair),

Guests:

D. Crossley (chairperson of GGP),
H.-G. Wenzel (president Earth Tide Commission),
I.Marson (president Gravity Commission)

Meetings:

1. Tokyo, Japan GraGeoMar 96 Symposium October 3, 96
2. Brussels, Belgium 13th International Symposium on Earth Tides, July 23, 1997
3. Munsbach, Luxemburg 2nd GGP workshop, March 25, 1999

Statements worked out within the working group:

To improve the high precision gravity observations with absolute and Superconducting gravimeters the responsible working groups in Austria, Belgium, Canada, China, Finland, France, Germany, Italy, Japan, USA are stimulated to use the two techniques as complementary tools.

The intensive inter-comparisons of absolute and Superconducting gravimeters as well as repeated observations at dedicated stations as Membach (Belgium), Strasbourg (France), Wettzell & Bad Homburg (Germany), Medicina (Italy), Boulder (USA), demonstrate the high level of the gravity recordings. The present day gravity instrumentation is capable to pick up long-term variations in the gravity signal at the 10 nms-2 level.

The combined analysis enables an operational control for both gravimeter types, the detection of instrumental drifts and offsets and the determination of calibration factors for the Superconducting gravimeter. But not all groups who are potentially capable make use of the great benefits of intensive inter-comparisons.

Results

From this working group there is no intention to set up in addition to existing monitoring global networks a new one. But the findings within this working group have already influenced the work of other groups like GGP where the combination of absolute and relative gravity data extended the spectrum for scientific investigations to the long term gravity variations.

Future needs

Local gravity time series are collected and handed by various groups e.g. GGP. Absolute gravity measurements are mainly used to determine the static gravity field e. g. set up gravity networks. The upcoming space gravity missions will improve the knowledge of the global gravity field, the static and the time varying part.

The space borne gravity information should be combined with the earth borne ones. The static gravity measurements on Earth are strongly locally biased e.g. by the topography respectively the density distribution. The long term time variations in the gravity field caused e.g. by annual signals are more regular and regional persistent. So those are more likely candidates for the combination or validation of the two types of gravity information.

The stations in the GGP network are not well distributed globally, there are clusters in Japan and Europe. The large gaps in the network will restrict global information. In Europe 8 stations equipped with Superconducting Gravimeters form a basis network. For long term gravity variations frequently repeated absolute gravimeter measurements at selected stations will give additional information. With the absolute gravimeter available in the region it should be possible to improve the European network so that 15 to 20 stations (“data point”) well distributed in a radius of 1000 km will supply information. These stationary information on the local variations in the gravity field have to be combined to an areal function e.g. expression in spherical functions which can be compared with the signals seen by the satellite for that region.

Proposal

To set up within section III or the gravity commission a SSG to deal with the combination of terrestrial data with the high quality time varying gravity data derived from the planned space missions. The terrestrial data have to be prepared in a manner that they are comparable with the space borne gravity data. It has to be investigated what regional gravity signals (sources, frequencies, quantities) are seen from the ground in

contrast to those seen from the space. As a test area the “relatively” dense European Network should be chosen. As a final goal a kind of service should be established which provide the ground information on a regularly schedule.