ASSOCIATION INTERNATIONALE DE GÉODÉSIE

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INTERNATIONAL

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N° 87

Décembre 2000

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INFORMATIONS for CONTRIBUTORS

Contributors should follow as closely as possible the rules below :

Manuscripts should be typed (single spaced), on one side of plain paper 21 cm x 29,7 cm with a 2 cm margin on the left and right hand sides as well as on the bottom, and with a 3 cm margin at the top (as indicated by the frame drawn on this page).

NOTA : *The publisher welcomes the manuscripts which have been prepared using WORD 6 for Macintosh and also accepts ASCII files on diskettes 3"5.*

Title of paper. Titles should be carefully worded to include only key words.

Abstract. The abstract of a paper should be informative rather than descriptive. It is not a table of contents. The abstract should be suitable for separate publication and should include all words useful for indexing. Its length should be limited to one typescript page.

Footnotes. Because footnotes are distracting, they should be avoided as much as possible.

Mathematics. For papers with complicated notation, a list of symbols and their definitions should be provided as an appendix. Symbols that must be handwritten should be identified by notes in the margin. Ample space (1.9 cm above and below) should be allowed around equations so that type can be marked for the printer. Where an accent or underscore has been used to designate a special type face (e.g., boldface for vectors, script for transforms, sans serif for tensors), the type should be specified by a note in a margin. Bars cannot be set over superscripts or extended over more than one character. Therefore angle brackets are preferable to accents over characters. Care should be taken to distinguish between the letter O and zero, the letter l and the number one, kappa and k, mu and the letter u, nu and v, eta and n, also subscripts and superscripts should be clearly noted and easily distinguished. Unusual symbols should be avoided.

Acknowledgements. Only significant contributions by professional colleagues, financial support, or institutional sponsorship should be included in acknowledgements.

References. A complete and accurate list of references is of major importance in review papers. All listed references should be cited in text. A complete reference to a periodical gives author (s), title of article, name of journal, volume number, initial and final page numbers (or statement "in press"), and year published. A reference to an article in a book, pages cited, publisher's location, and year published. When a paper presented at a meeting is referenced, the location, dates, and sponsor of the meeting should be given. References to foreign works should indicate whether the original or a translation is cited. Unpublished communications can be referred to in text but should not be listed. Page numbers should be included in reference citations following direct quotations in text. If the same information have been published in more than one place, give the most accessible reference ; e.g. a textbook is preferable to a journal, a journal is preferable to a technical report.

Table. Tables are numbered serially with Arabic numerals, in the order of their citation in text. Each table should have a title, and each column, including the first, should have a heading. Column headings should be arranged to that their relation to the data is clear.

Footnotes for the tables should appear below the final double rule and should be indicated by a, b, c, etc. Each table should be arranged to that their relation to the data is clear.

Illustrations. Original drawings of sharply focused glossy prints should be supplied, with two clear Xerox copies of each for the reviewers. Maximum size for figure copy is (25.4 x 40.6 cm). After reduction to printed page size, the smallest lettering or symbol on a figure should not be less than 0.1 cm high ; the largest should not exceed 0.3 cm. All figures should be cited in text and numbered in the order of citation. Figure legends should be submitted together on one or more sheets, not separately with the figures.

Mailing. Typescripts should be packaged in stout padded or stiff containers ; figure copy should be protected with stiff cardboard.

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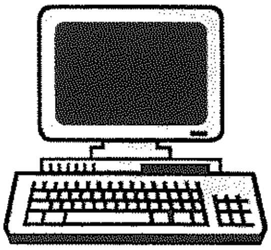

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BUREAU GRAVIMÉTRIQUE INTERNATIONAL

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Bulletin d'information n° 87

PART I

INTERNAL MATTERS

GENERAL INFORMATION

1. HOW TO OBTAIN THE BULLETIN

The Bulletin d'Information of the Bureau Gravimétrique International is issued twice a year, generally at the end of June and end of December.

The Bulletin contains general information on the community, on the Bureau itself. It informs about the data available, about new data sets...

It also contains contributing papers in the field of gravimetry, which are of technical character. More scientifically oriented contributions should better be submitted to appropriate existing journals.

Communications presented at general meeting, workshops, symposia, dealing with gravimetry (e.g. IGC, S.S.G.'s,...) are published in the Bulletin when appropriate - at least by abstract.

Once every four years, an issue contains the National Reports as presented at the International Gravity Commission meeting. Special issues may also appear (once every two years) which contain the full catalogue of the holdings.

About three hundred individuals and institutions presently receive the Bulletin.

You may :

- either request a given bulletin, by its number (86 have been issued as of June 30, 2000 but numbers 2,16, 18,19 are out of print).

- or subscribe for regularly receiving the two bulletins per year (the special issues are obtained at additional cost).

Requests should be sent to:

Mrs. Nicole LESTIEU
CNES/BGI
18, Avenue Edouard Belin
31401 TOULOUSE CEDEX 4 - FRANCE

Bulletins are sent on an exchange basis (free of charge) to individuals, institutions which currently provide informations, data to the Bureau. For other cases, the price of each issue is 75 FF.

2. HOW TO REQUEST DATA

2.1. Stations descriptions Diagrams for Reference, Base Stations (including IGSN 71's)

Request them by number, area, country, city name or any combination of these.

When we have no diagram for a given request, but have the knowledge that it exists in another center, we shall in most cases forward the request to this center or/and tell the inquiring person to contact the center.

Do not wait until the last moment (e.g. when you depart for a cruise) for asking us the information you need: station diagrams can only reach you by mail, in many cases.

2.2. G-Value at Base Stations

Treated as above.

2.3. Mean Anomalies, Mean Geoid Heights, Mean Values of Topography

The geographic area must be specified (polygon). According to the data set required, the request may be forwarded in some cases to the agency which computed the set.

2.4. Gravity Maps

Request them by number (from the catalogue), area, country, type (free-air, Bouguer...), scale, author, or any combination of these.

Whenever available in stock, copies will be sent without extra charges (with respect to usual cost - see § 3.3.2.). If not, two procedures can be used:

- we can make (poor quality) black and white (or ozalide-type) copies at low cost,

- color copies can be made (at high cost) if the user wishes so (after we obtain the authorization of the editor).

The cost will depend on the map, type of work, size, etc... In both cases, the user will also be asked to send his request to the editor of the map before we proceed to copying.

2.5. Gravity Measurements

2.5.1. CD-Roms

The non confidential data, which have been validated by various procedures are available on two CD-ROMs.

The price of these is :

- *800 (Eight hundred) French francs for individual scientists, universities and research laboratories or groups working in geodesy or geophysics.*
- *3000 (Three thousand) French francs for all other users.*

Most essential quantities are given, in a compressed format. The package includes a user's guide and software to retrieve data according to the area, the source code, the country.

2.5.2. Data stored in the general data base

BGI is now using the ORACLE Data Base Management System. One implication is that data are stored in only one format (though different for land and marine data), and that archive files do not exist anymore.

There are two distinct formats for land or sea gravity data, respectively EOL and EOS.

EOL
LAND DATA FORMAT
RECORD DESCRIPTION
126 characters

Col. 1-8 B.G.I. source number (8 char.)

9-16 Latitude (unit : 0.00001 degree) (8 char.)

17-25 Longitude (unit : 0.00001 degree) (9 char.)

26-27 Accuracy of position (2 char.)

The site of the gravity measurements is defined in a circle of radius R

- 0 = no information
- 1 - R <= 5 Meters
- 2 = 5 < R <= 20 M (approximately 0'01)
- 3 = 20 < R <= 100 M
- 4 = 100 < R <= 200 M (approximately 0'1)
- 5 = 200 < R <= 500 M
- 6 = 500 < R <= 1000 M
- 7 = 1000 < R <= 2000 M (approximately 1')
- 8 = 2000 < R <= 5000 M
- 9 = 5000 M < R
- 10...

28-29 System of positioning (2 char.)

- 0 = no information
- 1 = topographical map
- 2 = trigonometric positioning
- 3 = satellite

30 Type of observation (1 char.)

- 1 = current observation of detail or other observations of a 3rd or 4th order network
- 2 = observation of a 2nd order national network
- 3 = observation of a 1st order national network
- 4 = observation being part of a nation calibration line
- 5 = coastal ordinary observation (Harbour, Bay, Sea-side...)
- 6 = harbour base station

31-38 Elevation of the station (unit : centimeter) (8 char.)

39-40 Elevation type (2 char.)

- 1 = Land
- 2 = Subsurface
- 3 = Lake surface (above sea level)
- 4 = Lake bottom (above sea level)
- 5 = Lake bottom (below sea level)
- 6 = Lake surface (above sea level with lake bottom below sea level)
- 7 = Lake surface (below sea level)
- 8 = Lake bottom (surface below sea level)
- 9 = Ice cap (bottom below sea level)
- 10 = Ice cap (bottom above sea level)
- 11 = Ice cap (no information about ice thickness)

41-42 Accuracy of elevation (2 char.)

- 0 = no information
- 1 = E <= 0.02 M
- 2 = .02 < E <= 0.1 M
- 3 = .1 < E <= 1
- 4 = 1 < E <= 2
- 5 = 2 < E <= 5
- 6 = 5 < E <= 10
- 7 = 10 < E <= 20
- 8 = 20 < E <= 50
- 9 = 50 < E <= 100
- 10 = E superior to 100 M

43-44	Determination of the elevation	(2 char.)
	0 = no information	
	1 = geometrical levelling (bench mark)	
	2 = barometrical levelling	
	3 = trigonometric levelling	
	4 = data obtained from topographical map	
	5 = data directly appreciated from the mean sea level	
	6 = data measured by the depression of the horizon	
	7 = satellite	
45-52	Supplemental elevation (unit : centimeter)	(8 char.)
53-61	**Observed gravity** (unit : microgal)	(9 char.)
62-67	**Free air anomaly** (0.01 mgal)	(6 char.)
68-73	**Bouguer anomaly** (0.01 mgal)	(6 char.)
	Simple Bouguer anomaly with a mean density of 2.67. No terrain correction	
74-76	Estimation standard deviation free-air anomaly (0.1 mgal)	(3 char.)
77-79	Estimation standard deviation bouguer anomaly (0.1 mgal)	(3 char.)
80-85	**Terrain correction** (0.01 mgal)	(6 char.)
	computed according to the next mentioned radius & density	
86-87	Information about terrain correction	(2 char.)
	0 = no topographic correction	
	1 = tc computed for a radius of 5 km (zone H)	
	2 = tc computed for a radius of 30 km (zone L)	
	3 = tc computed for a radius of 100 km (zone N)	
	4 = tc computed for a radius of 167 km (zone 02)	
	11 = tc computed from 1 km to 167 km	
	12 = tc computed from 2.3 km to 167 km	
	13 = tc computed from 5.2 km to 167 km	
	14 =tc (unknown radius)	
	15 = tc computed to zone M (58.8 km)	
	16 = tc computed to zone G (3.5 km)	
	17 = tc computed to zone K (18.8 km)	
	25 = tc computed to 48.6 km on a curved Earth	
	26 = tc computed to 64. km on a curved Earth	
88-91	Density used for terrain correction	(4 char.)
92-93	Accuracy of gravity	(2 char.)
	0 = no information	
	1 = E <= 0.01 mgal	
	2 = .01 < E <= 0.05 mgal	
	3 = .05 < E <= 0.1 mgal	
	4 = 0.1 < E <= 0.5 mgal	
	5 = 0.5 < E <= 1. mgal	
	6 = 1. < E <= 3. mgal	
	7 = 3. < E <= 5. mgal	
	8 = 5. < E <= 10 mgal	
	9 = 10. < E <= 15. mgal	
	10 = 15. < E <= 20. mgal	
	11 = 20. < E mgal	
94-99	Correction of observed gravity (unit : microgal)	(6 char.)
100-105	**Reference station**	(6 char.)
	This station is the base station (BGI number) to which the concerned station is referred	

106-108	Apparatus used for the measurement of G 0.. no information 1.. pendulum apparatus before 1960 2.. latest pendulum apparatus (after 1960) 3.. gravimeters for ground measurements in which the variations of G are equilibrated of detected using the following methods : 30 = torsion balance (Thyssen...) 31 = elastic rod 32 = bifilar system 34 = Boliden (Sweden) 4.. Metal spring gravimeters for ground measurements 41 = Frost 42 = Askania (GS-4-9-11-12), Graf 43 = Gulf, Hoyt (helical spring) 44 = North American 45 = Western 47 = Lacoste-Romberg 48 = Lacoste-Romoerg, Model D (microgravimeter) 5.. Quartz spring gravimeter for ground measurements 51 = Norgaard 52 = GAE-3 53 = Worden ordinary 54 = Worden (additional thermostat) 55 = Worden worldwide 56 = Cak 57 = Canadian gravity meter, sharpe 58 = GAG-2 59 = SCINTREX CG2 6.. Gravimeters for under water measurements (at the bottom of the sea or of a lake) 60 = Gulf 62 = Western 63 = North American 64 = Lacoste-Romberg	(3 char.)
109-111	**Country code** (BGI)	(3 char.)
112	**Confidentiality** 0 = without restriction .....1 = with authorization 2 = classified	(1 char.)
113	**Validity** 0 = no validation 1 = good 2 = doubtful 3 = lapsed	(1 char.)
114-120	Numbering of the station (original)	(7 char.)
121-126	Sequence number	(6 char.)

EOS
SEA DATA FORMAT
RECORD DESCRIPTION
146 characters

Col. 1-8 **B.G.I.** source number (8 char.)

9-16 **Latitude** (unit : 0.00001 degree) (8 char.)

17-25 **Longitude** (unit : 0.00001 degree) (9 char.)

26-27 Accuracy of position (2 char.)

The site of the gravity measurements is defined in a circle of radius R

0 = no information
1 - R <= 5 Meters
2 = 5 < R <= 20 M (approximately 0'01)
3 = 20 < R <= 100 M
4 = 100 < R <= 200 M (approximately 0'1)
5 = 200 < R <= 500 M
6 = 500 < R <= 1000 M
7 = 1000 < R <= 2000 M (approximately 1')
8 = 2000 < R <= 5000 M
9 = 5000 M < R
10...

28-29 System of positioning (2 char.)

0 = no information
1 = Decca
2 = visual observation
3 = radar
4 = loran A
5 = loran C
6 = omega or VLF
7 = satellite
8 = solar/stellar (with sextant)

30 Type of observation (1 char.)

1 = individual observation at sea
2 = mean observation at sea obtained from a continuous recording

31-38 **Elevation of the station** (unit : centimeter) (8 char.)

39-40 Elevation type (2 char.)

1 = ocean surface
2 = ocean submerged
3 = ocean bottom

41-42 Accuracy of elevation (2 char.)

0 = no information
1 = E <= 0.02 Meter
2 = .02 < E <= 0.1 M
3 = .1 < E <= 1
4 = 1 < E <= 2
5 = 2 < E <= 5
6 = 5 < E <= 10
7 = 10 < E <= 20
8 = 20 < E <= 50
9 = 50 < E <= 100
10 = E superior to 100 Meters

43-44 Determination of the elevation (2 char.)

0 = no information
1 = depth obtained with a cable (meters)
2 = manometer depth
3 = corrected acoustic depth (corrected from Mathew's tables, 1939)
4 = acoustic depth without correction obtained with sound speed 1500 M/sec. (or 820 fathom/sec)
5 = acoustic depth obtained with sound speed 1463 M/sec (800 fathom/sec)
6 = depth interpolated on a magnetic record
7 = depth interpolated on a chart

45-52 Supplemental elevation (8 char.)

53-61 **Observed gravity** (unit : microgal) (9 char.)

62-67 **Free air anomaly** (0.01 mgal) (6 char.)

68-73	**Bouguer anomaly** (0.01 mgal)	(6 char.)
	Simple Bouguer anomaly with a mean density of 2.67. No terrain correction	
74-76	Estimation standard deviation free-air anomaly (0.1 mgal)	(3 char.)
77-79	Estimation standard deviation bouguer anomaly (0.1 mgal)	(3 char.)
80-85	**Terrain correction** (0.01 mgal)	(6 char.)
	computed according to the next mentioned radius & density	
86-87	Information about terrain correction	(2 char.)
	0 = no topographic correction	
	1 = tc computed for a radius of 5 km (zone H)	
	2 = tc computed for a radius of 30 km (zone L)	
	3 = tc computed for a radius of 100 km (zone N)	
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	14 =tc (unknown radius)	
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	16 = tc computed to zone G (3.5 km)	
	17 = tc computed to zone K (18.8 km)	
	25 = tc computed to 48.6 km on a curved Earth	
	26 = tc computed to 64. km on a curved Earth	
88-91	Density used for terrain correction	(4 char.)
92-93	Mathew's zone	(2 char.)
	when the depth is not corrected depth, this information is necessary. For example : zone 50	
	for the Eastern Mediterranean Sea	
94-95	Accuracy of gravity	(2 char.)
	0 = no information	
	1 = E <= 0.01 mgal	
	2 = .01 < E <= 0.05 mgal	
	3 = .05 < E <= 0.1 mgal	
	4 = 0.1 < E <= 0.5 mgal	
	5 = 0.5 < E <= 1. mgal	
	6 = 1. < E <= 3. mgal	
	7 = 3. < E <= 5. mgal	
	8 = 5. < E <= 10. mgal	
	9 = 10. < E <= 15. mgal	
	10 = 15 < E <= 20. mgal	
	11 = 20. < E mgal	
96-101	Correction of observed gravity (unit : microgal)	(6 char.)
102-110	Date of observation	(9 char.)
	in Julian day - 2 400 000 (unit : 1/10 000 of day)	
111-113	Velocity of the ship (0.1 knot)	(3 char.)
114-118	Eötvös correction (0.1 mgal)	(5 char.)
119-121	**Country code** (BGI)	(3 char.)
122	**Confidentiality**	(1 char.)
	0 = without restriction	
	1 = with authorization	
	2 = classified	
123	**Validity**	(1 char.)
	0 = no validation	
	1 = good	
	2 = doubtful	
	3 = lapsed	
124-130	Numbering of the station (original)	(7 char.)
131-136	**Sequence number**	(6 char.)
137-139	**Leg number**	(3 char.)
140-145	**Reference station**	(6 char.)

Whenever given, the theoretical gravity (γ_o), free-air anomaly (FA), Bouguer anomaly (BO) are computed in the 1967 geodetic reference system.

The approximation of the closed form of the 1967 gravity formula is used for theoretical gravity at sea level:

$$\gamma_o = 978031.85 * [1 + 0.005278895 * \sin^2 (\phi) + 0.000023462 * \sin^4 (\phi)] \text{, mgals}$$

where ϕ is the geographic latitude.

The formulas used in computing FA and BO are summarized below.

Formulas used in computing free-air and Bouguer anomalies

Symbols used :

g	*: observed value of gravity*
γ	*: theoretical value of gravity (on the ellipsoid)*
Γ	*: vertical gradient of gravity (approximated by 0.3086 mgal/meter)*
H	*: elevation of the physical surface of the land, lake or glacier (H = o at sea surface), positive upward*
D_1	*: depth of water, or ice, positive downward*
D_2	*: depth of a gravimeter measuring in a mine, in a lake, or in an ocean, counted from the surface, positive downward*
G	*: gravitational constant ($667.2\ 10^{-13}\ m^3\ kg^{-1}\ s^{-2}$) $\Rightarrow k = 2\pi G$*
ρ_c	*: mean density of the Earth's crust (taken as 2670 $kg\ m^{-3}$)*
ρ_w^f	*: density of fresh water (1000 $kg\ m^{-3}$)*
ρ_w^s	*: density of salted water (1027 $kg\ m^{-3}$)*
ρ_i	*: density of ice (917 $kg\ m^{-3}$)*
FA	*: free-air anomaly*
BO	*: Bouguer anomaly*

Formulas :

* *FA : The principle is to compare the gravity of the Earth at its surface with the normal gravity, which first requires in some cases to derive the surface value from the measured value. Then, and until now, FA is the difference between this Earth's gravity value reduced to the geoid and the normal gravity γ_o computed on the reference ellipsoid (classical concept). The more modern concept *, in which the gravity anomaly is the difference between the gravity at the surface point and the normal (ellipsoidal) gravity on the telluroid corresponding point may be adopted in the future depending on other major changes in the BGI data base and data management system.*

* *BO : The basic principle is to remove from the surface gravity the gravitational attraction of one (or several) infinite plate (s) with density depending on where the plate is with respect to the geoid. The conventional computation of BO assumes that parts below the geoid are to be filled with crustal material of density ρ_c and that the parts above the geoid have the density of the existing material (which is removed).*

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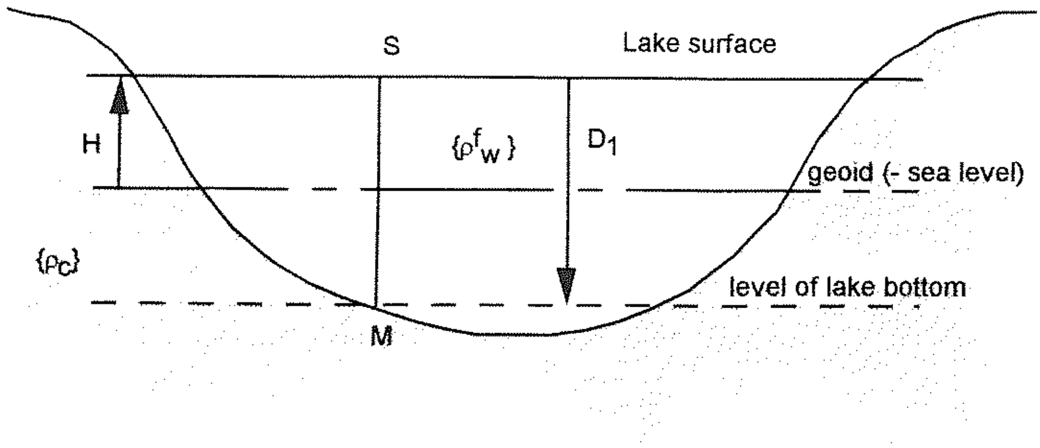
* cf. "On the definition and numerical computation of free air gravity anomalies", by H.G. Wenzel. Bulletin d'Information, BGI, n° 64, pp. 23-40, June 1989.

For example, if a measurement g_M is taken at the bottom of a lake, with the bottom being below sea level, we have :



$$g_S = g_M + 2\,k\,\rho_w^f\,D_1\ - \Gamma D_1$$

$$\Rightarrow FA = g_S + \Gamma H - \gamma_0$$

Removing the (actual or virtual) topographic masses as said above, we find :

$$\begin{aligned}\delta g_s &= g_s - k\,\rho_w^f\,D_1 + k\,\rho_c(D_1 - H)\\ &= g_s - k\,\rho_w^f\,[H + (D_1 - H)] + k\,\rho_c\,(D_1 - H)\\ &= g_s - k\,\rho_w^f\,H + k\,(\rho_c - \rho_w^f)(D_1 - H)\end{aligned}$$

$$\Rightarrow \quad BO = \delta g_s + \Gamma\,H - \gamma_o$$

The table below covers most frequent cases. It is an update of the list of formulas published before.

It may be noted that, although some formulas look different, they give the same results. For instance BO (C) and BO (D) are identical since :

$$\begin{aligned}-\,k\,\rho_i H + k(\rho_c - \rho_i)(D_1 - H) &\equiv -\,k\,\rho_i(H - D_1 + D_1) - k(\rho_c - \rho_i)(H - D_1)\\ &\equiv -\,k\,\rho_i\,D_1 - k\,\rho_c(H - D_1)\end{aligned}$$

Similarly, BO (6), BO (7) and BO (8) are identical.

Elev. Type	Situation	Formulas
1	Land Observation-surface	$FA = g + \Gamma H - \gamma_0$ $BO = FA - k\,\rho_c\,H$
2	Land Observation-subsurface	$FA = g + 2\,k\,\rho_c\,D_2 + \Gamma(H - D_2) - \gamma_0$ $BO = FA - k\,\rho_c\,H$
3	Ocean Surface	$FA = g - \gamma_0$ $BO = FA + k\,(\rho_c - \rho_w^s)\,D_1$
4	Ocean submerged	$FA = g + (2\,k\,\rho_w^s - \Gamma)\,D_2 - \gamma_0$ $BO = FA + k\,(\rho_c - \rho_w^s)\,D_1$
5	Ocean bottom	$FA = g + (2\,k\,\rho_w^s - \Gamma)\,D_1 - \gamma_0$ $BO = FA + k\,(\rho_c - \rho_w^s)\,D_1$
6	Lake surface above sea level with bottom above sea level	$FA = g + \Gamma H - \gamma_0$ $BO = FA - k\,\rho_w^f\,D_1 - k\,\rho_c\,(H - D_1)$
7	Lake bottom, above sea level	$FA = g + 2\,k\,\rho_w^f\,D_1 + \Gamma(H - D_1) - \gamma_0$ $BO = FA - k\,\rho_w^f\,D_1 - k\,\rho_c\,(H - D_1)$
8	Lake bottom, below sea level	$FA = g + 2\,k\,\rho_w^f\,D_1 + \Gamma(H - D_1) - \gamma_0$ $BO = FA - k\,\rho_w^f\,H + k\,(\rho_c - \rho_w^f)\,(D_1 - H)$
9	Lake surface above sea level with bottom below sea level	$FA = g + \Gamma H - \gamma_0$ $BO = FA - k\,\rho_w^f\,H + k\,(\rho_c - \rho_w^f)\,(D_1 - H)$
A	Lake surface, below sea level (here $H < 0$)	$FA = g + \Gamma H - \gamma_0$ $BO = FA - k\,\rho_c H + k\,(\rho_c - \rho_w^f)\,D_1$
B	Lake bottom, with surface below sea level ($H < 0$)	$FA = g + (2\,k\,\rho_w^f - \Gamma)\,D_1 + \Gamma H - \gamma_0$ $BO = FA - k\,\rho_c H + k\,(\rho_c - \rho_w^f)\,D_1$
C	Ice cap surface, with bottom below sea level	$FA = g + \Gamma H - \gamma_0$ $BO = FA - k\,\rho_i\,H + k\,(\rho_c - \rho_i)\,(D_1 - H)$
D	Ice cap surface, with bottom above sea level	$FA = g + \Gamma H - \gamma_0$ $BO = FA - k\,\rho_i\,D_1 - k\,\rho_c\,(H - D_1)$

All requests for data must be sent to :

Mr. Bernard LANGELLIER
Bureau Gravimétrique International
18, Avenue E. Belin - 31401 Toulouse Cedex 4 - France
E-mail : Bernard.Langellier@cnes.fr

In case of a request made by telephone, it should be followed by a confirmation letter, or fax. Except in particular case (massive data retrieval, holidays...) requests are satisfied within one month following the reception of the written confirmation, or information are given concerning the problems encountered.

If not specified, the data will be written as tarfiles on DAT cartridge (4 mm). for large amounts of data, or on diskette in the case of small files. The exact physical format will be indicated in each case. Also a FTP anonymous service is available on our computer center.

3. USUAL SERVICES BGI CAN PROVIDE

The list below is not restrictive and other services (massive retrieval, special evaluation and products...) may be provided upon request.

The costs of the services listed below are a revision of the charging policy established in 1981 (and revised in 1989) in view of the categories of users : (1) contributors of measurements and scientists, (2) other individuals and private companies.

The prices given below are in French Francs. They have been effective on January 1, 1992 and may be revised periodically.

3.1. Charging Policy for Data Contributors and Scientists

For these users and until further notice, - and within the limitation of our in house budget, we shall only charge the incremental cost of the services provided. In all other cases, a different charging policy might be applied.

However, and at the discretion of the Director of B.G.I., some of the services listed below may be provided free of charge upon request, to major data contributors, individuals working in universities, especially students ...

3.1.1. Digital Data Retrieval

. on CD-Roms : see 2.5.1.
. on one of the following media :
** printout .... 2 F/100 lines*
** diskette...................... 25 F per diskette (minimum charge : 50 F-*
** magnetic tape .... 2 F per 100 records*
+ 100 F per DAT cartridge
(if the tape is not to be returned)

. minimum charge : 100 F

. maximum number of points : 100 000 ; massive data retrieval (in one or several batches) will be processed and charged on a case by case basis.

3.1.2. Data Coverage Plots : in Black and White, with Detailed Indices

. 20°x20° blocks, as shown on the next pages (maps 1 and 2) : 400 F each set.

. For any specified area (rectangular configurations delimited by meridians and parallels) : 1 F per degree square : 100 F minimum charge (at any scale, within a maximum plot size of : 90 cm x 180 cm).

. For area inside polygon : same prices as above, counting the area of the minimum rectangle comprising the polygon.

3.1.3. Data Screening

(Selection of one point per specified unit area, in decimal degrees of latitude and longitude, i.e. selection of first data point encountered in each mesh area).

. 5 F/100 points to be screened.

. 100 F minimum charge.

3.1.4. Gridding

(Interpolation at regular intervals Δ in longitude and Δ' in latitude - in decimal degrees) :

. 10 F/(ΔΔ') per degree square

. minimum charge : 150 F

. maximum area : 40° x 40°

3.1.5. Contour Maps of Bouguer or Free-Air Anomalies

At a specified contour interval Δ (1, 2, 5,... mgal), on a given projection :
10 F/Δ per degree square, plus the cost of gridding (see 3.4) after agreement on grid stepsizes. (at any scale, within a maximum map size for : 90 cm x 180 cm).

. 250 F minimum charge

. maximum area : 40° x 40°

3.1.6. Computation of Mean Gravity Anomalies

(Free-air, Bouguer, isostatic) over Δ xΔ' area : 10F/ΔΔ' per degree square.

. minimum charge : 150 F

. maximum area : 40°x40°

3.2. Charging Policy for Other Individuals or Private Cr mpanies

3.2.1. Digital Data Retrieval

. on CD-Roms : see 2.5.1.

. 1 F per measurement for non commercial use (guaranteed by signed agreement), 5 F per measurement in other cases (direct or indirect commercial use - e.g. in case of use for gridding and/or maps to be sold or distributed by the buyer in any project with commercial application). Minimum charge : 500 F

3.2.2. Data Coverage Plots, in Black and White, with Detailed Indices

. 2 F per degree square ; 100 F minimum charge. (maximum plot size = 90 cm x 180 cm)

. For area inside polygon : same price as above, counting the area of the smallest rectangle comprising ihe polygon.

3.2.3. Data Screening

. 1 F per screened point for non commercial use (guaranteed by signed agreement), 5 F per screened point in other cases (cf. 3.2.1.).

. 500 F minimum charge

3.2.4. Gridding

Same as 3.1.4.

3.2.5. Contour Maps of Bouguer or Free-Air Anomalies

Same as 3.1.5.

3.2.6. Computation of Mean Gravity Anomalies

Same as 3.1.6.

3.3. Gravity Maps

The pricing policy is the same for all categories of users

3.3.1. Catalogue of all Gravity Maps

Printout : 200 F
DAT cartridge (4 mm) 100 F

3.2.2. Maps

. Gravity anomaly maps (excluding those listed below) : 100 F each

. Special maps :

Mean Altitude Maps

FRANCE	(1: 600 000)	1948	6 sheets	65 FF the set
WESTERN EUROPE	(1:2 000 000)	1948	1 sheet	55 FF
NORTH AFRICA	(1:2 000 000)	1950	2 sheets	60 FF the set
MADAGASCAR	(1:1 000 000)	1955	3 sheets	55 FF the set
MADAGASCAR	(1:2 000 000)	1956	1 sheet	60 FF

Maps of Gravity Anomalies

NORTHERN FRANCE	Isostatic anomalies	(1:1 000 000)	1954	55 FF
SOUTHERN FRANCE	Isostatic anomalies Airy 50	(1:1 000 000)	1954	55 FF
EUROPE-NORTH AFRICA	Mean Free air anomalies	(1:1 000 000)	1973	90 FF

World Maps of Anomalies (with text)

PARIS-AMSTERDAM	Bouguer anomalies	(1:1 000 000)	1959-60	65 FF
BERLIN-VIENNA	Bouguer anomalies	(1:1 000 000)	1962-63	55 FF
BUDAPEST-OSLO	Bouguer anomalies	(1:1 000 000)	1964-65	65 FF
LAGHOUAT-RABAT	Bouguer anomalies	(1:1 000 000)	1970	65 FF
EUROPE-AFRICA	Bouguer Anomalies	(1:10 000 000)	1975	180 FF with text 120 FF without text
EUROPE-AFRICA	Bouguer anomalies-Airy 30	(1:10 000 000)	1962	65 FF

Charts of Recent Sea Gravity Tracks and Surveys (1:36 000 000)

CRUISES prior to	1970	65 FF
CRUISES	1970-1975	65 FF
CRUISES	1975-1977	65 FF

Miscellaneous

CATALOGUE OF ALL GRAVITY MAPS

listing	200 FF
tape	300 FF

THE UNIFICATION OF THE GRAVITY NETS OF AFRICA

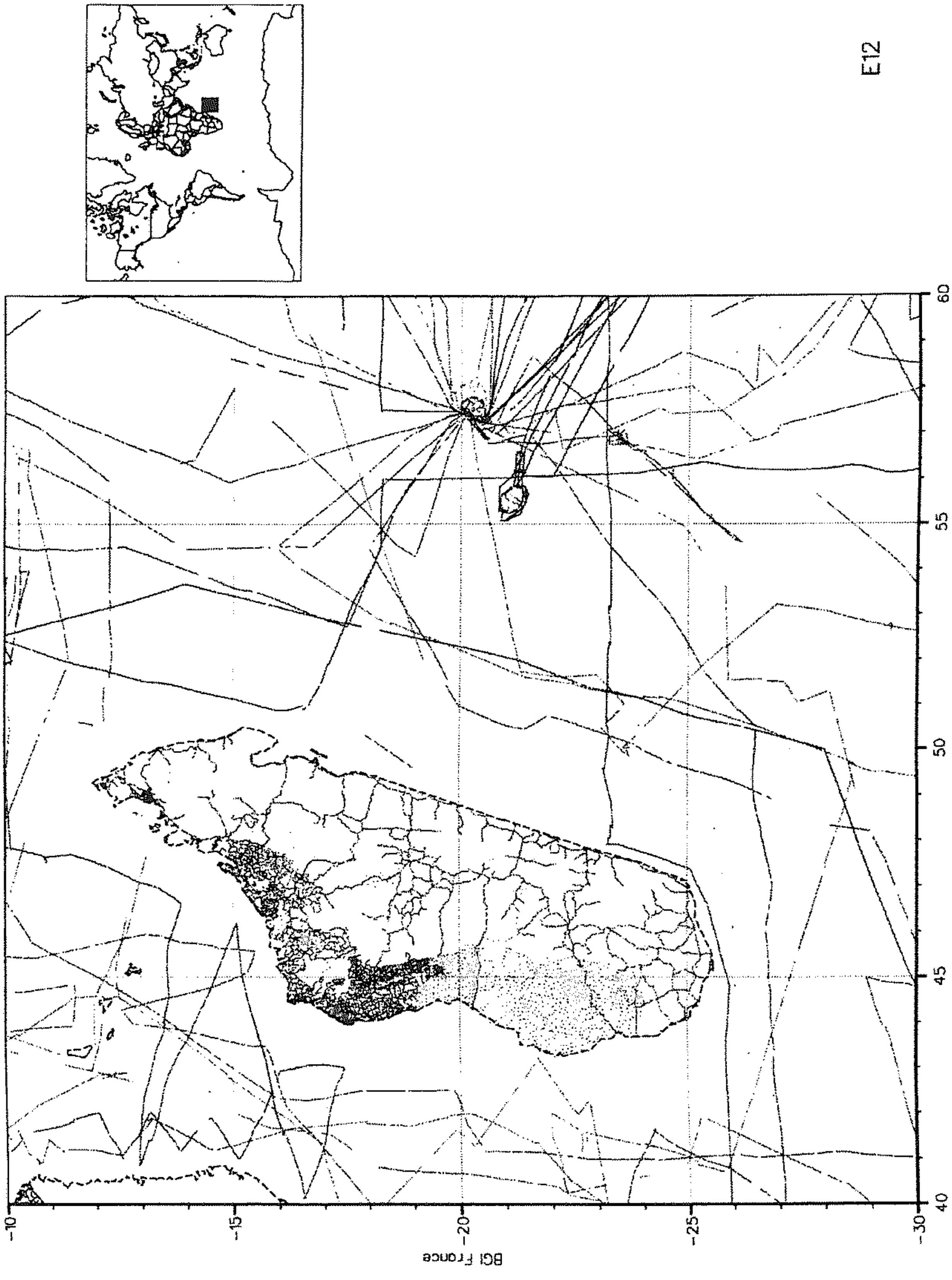
(Vol. 1 and 2) 1979 150 FF

. Black and white copy of maps : 150 F per copy

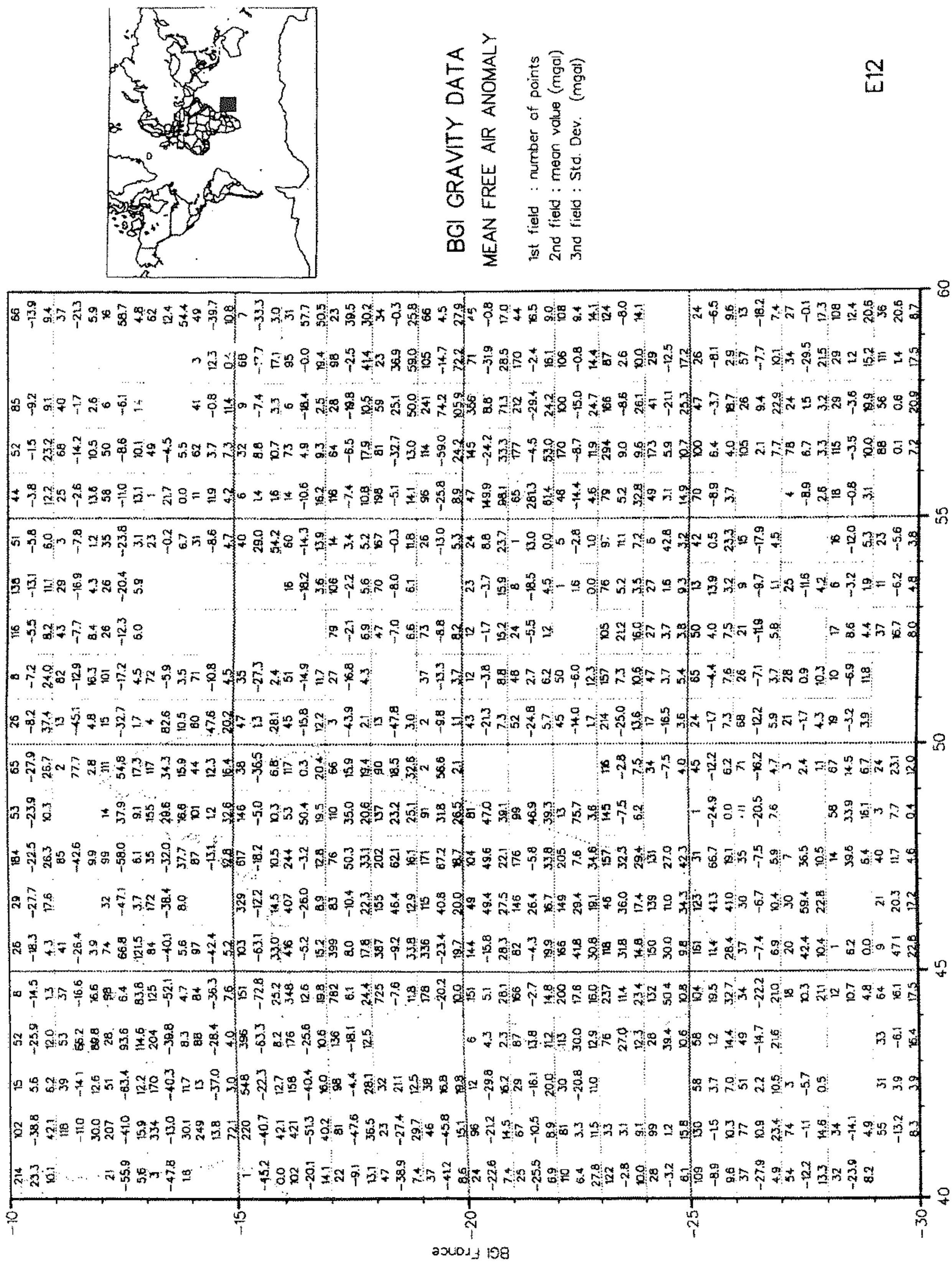
. Colour copy : price according to specifications of request.

Mailing charges will be added for air-mail parcels when "Air-Mail" is requested)

Map 1. Example of data coverage plot



Map 2. Example of detailed index (Data coverage corresponding to Map 1)



4. PROVIDING DATA TO B.G.I.

4.1. Essential Quantities and Information for Gravity Data Submission

1. Position of the site :

- *latitude, longitude (to the best possible accuracy),*
- *elevation or depth :*
  - *. for land data : elevation of the site (on the physical surface of the Earth)* *
  - *. for water stations : water depth.*

2. Measured (observed) gravity, corrected to eliminate the periodic gravitational effects of the Sun and Moon, and the instrument drift **

3. Reference (base) station (s) used. For each reference station (a site occupied in the survey where a previously determined gravity value is available and used to help establish datum and scale for the survey), give name, reference station number (if known), brief description of location of site, and the reference gravity value used for that station. Give the datum of the reference value ; example : IGSN 71.

4.2. Optional Information

The information listed below would be useful, if available. However, none of this information is mandatory.

. Instrumental accuracy :

- *identify gravimeter (s) used in the survey. Give manufacturer, model, and serial number, calibration factor (s) used, and method of determining the calibration factor (s).*
- *give estimate of the accuracy of measured (observed) gravity. Explain how accuracy value was determined.*

. Positioning accuracy :

- *identify method used to determine the position of each gravity measurement site*
- *estimate accuracy of gravity station positions. Explain how estimate was obtained.*
- *identify the method used to determine the elevation of each gravity measurement site.*
- *estimate accuracy of elevation. Explain how estimate was obtained. Provide supplementary information, for elevation with respect to the Earth's surface or for water depth, when appropriate.*

. Miscellaneous information :

- *general description of the survey.*
  date of survey : organization and/or party conducting survey.
- *if appropriate : name of ship, identification of cruise.*
- *if possible, Eötvös correction for marine data.*

. Terrain correction

Please provide brief description of method used, specify : radius of area included in computation, rock density factor used and whether or not Bullard's term (curvature correction) has been applied.

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* Give supplementary elevation data for measurements made on towers, on upper floor of buildings, inside of mines or tunnels, atop glacial ice. When applicable, specify whether gravity value applied to actual measurement site or it has been reduced to the Earth's physical surface (surface topography or water surface) Also give depth of actual measurement site below the water surface for underwater measurements.

** For marine gravity stations, gravity value should be corrected to eliminate effects of ship motion, or this effect should be provided and clearly explained.

. Isostatic gravity

Please specify type of isostatic anomaly computed.
Example : Airy-Heiskanen, T = 30 km.

. Description of geological setting of each site

4.3. Formats

Actually, any format is acceptable as soon as the essential quantities listed in 4.1. are present, and provided that the contributor gives satisfactory explanations in order to interpret his data properly.

The contributor may use the EOL and/or EOS formats as described above, or if he wishes so, the BGI Official Data Exchange Format established by BRGM in 1976 : "Progress Report for the Creation of a Worldwide Gravimetric Data Bank", published in BGI Bull. Info, n° 39, and recalled in Bulletin n° 50 (pages 112-113).

If magnetifc tapes are used, contributors are kindly asked to use 1600 bpi, unlabelled tapes (if possible), with no password, and formatted records of possibly fixed length and a fixed blocksize, too. Tapes are returned whenever specified, as soon as they are copied

PART II

BGI's DIRECTING BOARD, IGGC

BGI/IGeS

Minutes of the BGI/IGeS first Directing Board meeting

Monday, July 31, 2000

Location: Max Bell Building, room 150.
Banff Centre
Banff, Alberta

Present: Jean-Pierre Barriot, René Forsberg, Jacques Liard, Fernando Sansò, Michel Sarrailh, Martin Vermeer (President)

Jean-Pierre Barriot reported on the new structure of the Bureau Gravimétrique International since becoming its director in 1999, replacing George Balmino.

The membership list of the directing board was updated and discussed initially in the absence of the F. Sansò (who came in later during the meeting).

Voting members

M. Vermeer	IGGC president
R. Forsberg	IGGC vice president
M. Sideris	IGGC vice president
J.P. Barriot	BGI director
M. Sideris	Section III president
J.E. Faller?	to be elected
P. Medvedev?	to be elected
S. Takamoto	to be elected
J. Liard	IGGC secretary * proposed change in the voting structure *

Non voting members

L. Vitushkin	chairman of the ICAG WG
[to replace L. Robertsson]	
B. Richter	chairman "WG7"
(E. Klingelé)	To be established

Ex-officio

F. Sansò	IGeS director
P. Paquet	FAGS president

He also described the recent staffing changes

- G. Balma and D. Toustou, both technicians who left recently are replaced by B Langellier (engineer) and S. Pecquerie who will start in September, 2000 and will act as the documentalist.
- A short-term contract (6 months) with Pascal Rosenblatt was established to help in the updating efforts and in the software designs.

Activities that are finished or ongoing were described as well as proposed activities.

- BGI Activities report July 1999-July 2000

  - scanning of entire BGI database of gravity reference stations. (about 4600 stations). The corresponding database will be on line in March 2001 (the BGI is completing tests).

  - updating of the literature database. About 2000 recent publications (period of the 90's) have been re-entered into the database. To each publication, it has been addressed up to 5 key words chosen from an updated list. The literature database will be on line in June 2001 and the list of keywords will be published in the BGI Bulletin.

  - BGI involvement to the new gravimetric networks of North Africa, with O.S.S. (Observatoire du Sahara et du Sahel), O.A.C.T. (Organisation Africaine de Cartographie et de télédetection, O.T.C. (Office de Topographie et de Cartographie Tunisien).

  - BGI participation to IGeS Geoid Scholl in Johor (Malaysia).

  - new software for the detection of systematic errors on gravity data sets (shifts on coordinates). A poster has been presented during the Banff Conference in July-August 2000, and will be reproduced in the BGI Bulletin.

- BGI Activities planning July 2000-July 2001

  - On line downloading of the validation software for terrestrial gravimetry (July 2001). The software is currently being rewritten entirely in Java.

  - complete review of the contents, country by country, of the gravity database.

  - improving data collection. A systematic mailing to all interested parties will be done after the re-building of our address database.

  - study on the possibility of joint BGI/ICET summer schools (rela[illegible] gravimetry).

  - study on a possible federation of BGI and IGeS under an "umbrella", the Gravity Field and Figure of the Earth Service (GFFS).

  - study on the archiving of "test data sets" for the GRACE/GOCE missions.

He also emphasized that for the moment he was completing ongoing projects before going onto other activities.

Michel Sarrailh presented a brief summary of the new software for the detection and correction of systematic errors in gravity data sets.

Finally, F. Sansò and J.P. Barriot agreed to start combining their respective bulletins into one bulletin.

Further discussions would follow in the first IGGC meeting as well as the GFFS open session.

Jacques Liard, November 16, 2000

International Gravity and Geoid Commission Banff

Minutes of the First Assembly of the IGGC

Location: Banff Centre, Banff, Alberta, Canada
Room 252.
Date: 2000-08-01

Present at the meeting:

M. Emin Ayham, Jean-Pierre Barriot, Denizar Blitzkow, Alessandro Capra, Heiner Denker, Michel Everaerts, René Forsberg, Erik Grafarend, Thomas Gruber, Petr Holota, Chris Jekeli, Harli Jurgenson, Janis Kaminskis, Bill Kearsley, Ambrus Kenyeres, Anthony Lambert, Jacques Liard, Jaakko Makinen, Marcel Mojzes, Spiros Pagiatakis, Merrin Pearse, Michel Sarrailh, Uwe Schafer, Michael Sideris, Lars Sjöberg, Dag Solheim, Ilias.N. Tziavos, Martin Vermeer (President). Leonid Vitushkin.

Agenda

1. Opening, establishing authority in legal and decision making matters
2. Choice of meeting chairman, secretary, two vote counters cum inspectors of the Minutes
3. Chair's Report on IGGC events since its establishment in Birmingham
4. Proposal for organization of IGGC [as in the Terms of Reference]:
   4.1 Election of two vice-presidents. Chair proposes currently acting (temporary) vice presidents, Michael Sideris (Section Chair) and René Forsberg.
   4.2 Election of Secretary. Chair proposes Jacques Liard, currently acting (temporary) secretary. President, Secretary and Vice-Presidents constitute the Executive Board.
   4.3 Subcommissions:
   The Chair proposes to elect all acting (temporary) SC presidents for the 4-year period following the Assembly.
   - SC for Europe, Ambrus Kenyeres
   - SC for South America, Denizar Blitzkow
   - SC for South-East Asia, Bill Kearsley
   - SC for North America, Marc Véronneau
   - Any other SC that are proposed (proposals welcome)
   4.4 Working groups:
   The Chair proposes to elect all acting (temporary) WG presidents for the 4-year period following the Assembly.
   - WG on International Comparison of Absolute Gravimeters, Leonid Vitushkin
   - WG on the Arctic Gravity Project, René Forsberg
   - WG on Antarctica, Alessandro Capra
   New WGs:
   - WG on World Gravity Standards, Gerd Boedecker
   - WG on the Global Gravity Monitoring Network, Bernd Richter
5. The Services:
   5.1 BGI Report on Activities (Jean-Pierre Barriot)
   5.2 IGeS Report on Activities (Fernando Sansò)
   5.3 Official matters
6. Presentations by WG/SC Presidents: Current status, plans for the future.

7. Technical Advisory Group:
   Chair proposes establishment of a TAG [idea shamelessly borrowed from EUREF] consisting of the members of the Executive Board, Directors of the Services, Presidents of WGs and SCs, and any other representatives of interest groups that the EB may invite, either permanently or on a one-time basis.
   The task of the TAG is to, without prejudicing what is said in Terms of Reference §4, assist in an advisory role the EB in executing its functions in a timely way.
   Because the members of the group are distributed all over the globe, they, unlike the EUREF TWG, will not often meet in person, usually in connection with other international meetings. Electronic communication should make up for this. The important role of the TAG is to provide feedback and good ideas to the EB, as these are the people most directly involved in the practical work of the IGGC.
8. Co-operation with other Commissions and organizations. Proposals invited.
9. Varia
10. Closing

Minutes

Prior to starting with the Agenda, the President of the commission brought to the attention of the assembly Item 7 and proposed the establishment of a Technical Advisory Group similar to the EUREF TWG.

Items 1, 2, 3 on the agenda were quickly passed as there were no reports of activity since the formation of the new commission. Also, since no volunteers came forward as inspectors of the Minutes, the president named the two vice-presidents as inspectors.

Item 4.0 (Point 4 of the "Terms of Reference") was accepted.

Bill Kearsley seconded points 4.1 and 4.2 with no opposition from any member on the elections of the two vice-presidents and the secretary.

Item 4.3, the election of SC presidents were voted in as presented in the Agenda one after the other with no opposition. No new Sub Commission proposal was presented.

Item 4.4, the election of WG presidents were voted in for the WG on International Comparison of Absolute Gravimeters, for the WG on the Arctic Gravity Project, and for the WG on Antarctica, as presented in the Agenda.

The elections of two WG presidents were accepted even in the absence of the proposed members: WG on World Gravity Standards (G. Boedecker) and WG on the Global Gravity Monitoring Network (B. Richter). Both members would be contacted by e-mail on their accepted participation.

Item 5.1, J.P. Barriot reported on BGI activities [see BGI Report on the same Bulletin).

René Forsberg proposed that SC presidents meet with BGI to help co-ordinate the efforts of the BGI. Asked by W. Kearsley, the BGI director mentioned that the new Java application for gravity data sets validation would be available for download since it would be difficult to have the application operate online.

Item 5.2 was skipped over due to the absence of its director, Fernando Sansò.

Item 5.3: Official matters. Yesterday's (2000/07/31) list of voting/non-voting members of the BGI was presented. It was proposed that Erik Grafarend be included as a voting member which was accepted.

Voting members

M. Vermeer	IGGC president
R. Forsberg	IGGC vice president
M. Sideris	IGGC vice president
J.P. Barriot	BGI director
M. Sideris	Section III president
E. Grafarend	elected
J.E. Faller?	to be elected
P. Medvedev?	to be elected
S. Takamoto	to be elected
J. Liard	IGGC secretary * proposed change in the voting structure *

Non voting members

L. Vitushkin [to replace L. Robertsson]	chairman of the ICAG WG
B. Richter	chairman "WG7"
(E. Klingelé)	To be established

Ex-officio

F. Sansò	IGeS director
P. Paquet	FAGS president

For the organisation of the IGeS, the name of JP Barriot and F Sansò are exchanged in the above Table.

Sub-Commission presidents presentations:

SC Europe: (Kenyeres) - (see Report on the same Bulletin)

SC South-East Asia: (Kearsley)

- The main difficulty in setting up this body is that there is no general IAG Group coordinating geodetic activities in the region. Any Sub-commission of the IGGC (IGeC) had therefore to start from scratch.
- Another major difficulty is that the attendance at IAG symposia by delegates from the region is very limited, making it hard to set up formal meetings for the Sub-commission.
- Nevertheless, there have been positive developments. The Directors of both National Mapping, Indonesia and of Department of Surveying and Mapping, Malaysia and the Surveyors-General of Papua New Guinea, Singapore and Vietnam have supported the Sub-commission. (Unfortunately, the key countries of Thailand and the Philippines have not responded to the invitation).
- There have been some campaigns in the region which will provide direct benefit to the effort of this sub-commission - notably GEODYSSEA (a campaign to study crustal deformation in the SE Asian region) and the Asia-Pacific Space Geodynamics Program (APSG), which encompasses the region, and has a proactive campaign to link the space-based (GPS/SLR/...) control to the national height datums.

- A very successful Geoid School, sponsored by the IAG/IGeS, was held in Johor, Malaysia, in February, 2000. It was attended by over 40 people, and the lectures were given by Sanso, Barzhagi, Forsberg, Sideris and Kearsley.

SC South America: (Blitzkow)

The SCGGSA (Sub-Commission for Gravity and Geoid in South America) has been working in South America in a constant effort to improve the knowledge of the gravity field and the geoid. A few versions of the geoid have been computed, the last one was a common effort between IGeS, NIMA and SCGGSA. The DTM is another important effort that has been done with quite many new topographic maps being digitized. In the present year new gravity surveys are being undertaken in Brazil, Argentina, Chile and Paraguay at the year 2000. While the Paraguay geoid model is finalised, many countries and different organizations are involved with surveys and geoid computations in South America. The Amazon presents a big problem and the only solution may be airborne gravimetry.

SC North America: (Véronneau, absent).

Working Group presidents presentations:

ICAG WG (Vitushkin),

- L. Vitushkin has accepted to organise the WG and draft for participants
- The next ICAG will be held at the BIPM in July, 2001 because of minimum seismicity and a new building will be built for the comparison site
- There should be two subgroups to the WG, one for the ICAG proper and another for the regional comparisons.
- ICAG results should be published within a year of the comparison
- BIPM would provide a specialist for one year
- Early publication could be done in BIPM Reports and a 1-2 day workshop would be organised during the ICAG
- Regional comparisons should be prepared along the same lines as the formal ICAG. Sites need to be selected and proposals made officially by the participating agencies
- A problem exists where only participating countries (to IUGG or BIPM) can be part of these efforts
- Under geophysical and metrological considerations, should there be a WG on gravimetry in the CIPM? Proposals should come from member countries and not from BIPM [Russia and China have already done so] – Erwin Groten should be contacted since he is a member of the WG3 on Constants
- Tracebility is getting to be important in many spheres of activities so this point should be given serious considerations
- Finally, if regional comparisons are not organised in the context of the ICAG proper, BIPM might stop the ICAG at the BIMP site .

Arctic WG (Forsberg),

ArcGP is a WG under IGGC, aiming at producing a 5' public-domain free-air grid of the whole Arctic region north of 64N by 2001. Project has good progress, and most countries and active research groups in the area have contributed data, with the exception of Russia. Based on

ArcGP workshop held in St. Petersburg, Russia, June 2000, it can be assumed that Russian data in the Polar Sea can eventually be included in some form in the project. The ArcGPO is chaired by René Forsberg, with NIMA acting as operational centre for merging all the different data sources. NIMA has also contributed major data sets from airborne activities covering nearly half of the Arctic Ocean region.

A similar initiative is currently in preparation for Antarctica, under the leadership of A. Capra, Italy. As part of this initiative a national US proposal has recently been submitted to NSF for covering the central, most inaccessible parts of the continent.

WG on Antarctica (Capra),

- The Scientific Committee on Antarctic Research (SCAR) was briefly presented.
- There is a need to create a gravity and geodetic database, as well as an airborne gravity database
- There are gaps in the Antarctic coverage at 82 – 83° S.

Item 7 was briefly mentioned at the beginning of the meeting but no time was left for this item after the SC/WG presentations. One problem remains: this Technical Advisory Group is not part of the Terms of Reference of the IGGC.

The meeting was adjourned after no new proposals (points 8 & 9) were presented.

Jacques Liard, November 16, 2000

Report of the European Subcommission of the International Geoid and Gravity Commission (IGGC)

Prepared for the IGGC 1st General Assembly

August, 2000
Banff, Canada

Preamble

The European Subcommission of the IGGC (IAG Section III, Commission XIII) is the successor of the European Subcommission for the International Geoid Commission, chaired by Martin Vermeer. The transition was decided at the IUGG/IAG General Assembly held in Birmingham, July 1999. The primary aim was to create more close relation between survey gravimetry and geoid determination in order to achieve further support for the realization of more precise gravimetric geoid solutions both on regional and national level.

During the existence of the former European Subcommission (ESc) the determination of the precise European Gravimetric Reference geoid solution, the EGG97 was completed successfully. The gravimetric data compilation, validation, theoretical and methodological investigations and the geoid computations were done at the Computing Centre of the ESc, acting at the Institute für Erdmessung in Hanover. The whole geoid community highly appreciates the support of Professor Torge and the big job done by Dr Heiner Denker. The Subcommission is also thankful to all persons and national agencies, who supported this successful work providing gravity and terrain data for the computations.

Status and future tasks

The change in the name of the Commissions also means the change in the tasks. Beyond the primary commitment - the improvement of the European reference geoid - the support of the development of national gravimetric databases, the support of the international gravity data exchange and the build-up of an improved regional gravimetric database are becoming essential tasks of the new organization. Therefore the Subcommission wants to involve people both from the geoid and gravimetric communities.

The basic body of the ESc is the Computing Centre in Hanover. Heiner Denker expressed his interest to continue further his activity. The improvement of the reference geoid is a stepwise process. A new EGG solution is only to be computed, when significant improvement is achieved in the gravimetric databases concerning the availability and quality of altimetric and terrestrial gravimetric measurements and geopotential models. In this respect we may expect a major improvement from the results of the recently launched CHAMP and the follow-on gradiometric missions.

Beyond the general formulation of the tasks the following important actual issues should be addressed:

- ***Collection of a GPS/leveling benchmark dataset***
  The EGG97 gravimetric geoid is proved to be an accurate regional reference solution. Its accuracy in well-surveyed areas was proved to be a few cm, but it still incorporates long-wavelength distortions due to biases in the input gravimetric datasets. The most efficient solution to determine and may eliminate such distortions is the use of a highly reliable GPS/leveling dataset in a uniform reference system. In Europe the EUREF is the only organisation, which is able to support such dataset, therefore the close cooperation between our subcommissions are essential. EUREF has made significant and successful efforts to establish a uniform European reference frame for 3D

surveying (EUREF89) and also for vertical surveying (UELN95/98 and EUVN). The president of the IGGC ESc is officially member of the EUREF Technical Working Group (TWG), which is the directing body of the EUREF. In the last meeting of the EUREF TWG in Tromsø I asked EUREF to support the geoid community with the collection of a GPS/leveling benchmark dataset. This request had been accepted and was formulated in a resolution of the symposium:

Resolutions of the EUREF Symposium in Tromsø, 22-24 June 2000

Resolution No.3

The IAG Subcommission for Europe (EUREF)

noting resolution 3 of the EUREF Symposium 1998 in Bad Neuenahr-Ahrweiler,

recognising the completion of the EUVN height solution, which includes GPS/leveling geoid heights,

thanks the National Mapping Agencies for their support in supplying data,

recommends that the GPS/leveling heights of the EUVN solution should be used as fiducial control for the future European geoid determinations,

asks the relevant authorities

- to provide the necessary information for tide gauge connections,
- to densify the network of EUVN GPS/leveling geoid heights,

to complete and extend the EUVN project.

The first approaches of this database are the points included into the EUVN project. The freely accessible database consists of more than 200 points having coordinates in a uniform system with the highest accuracy presently available. The above resolution asks the relevant authorities to further densify this database.

The IGGC ESc asks also his members to do efforts in her/his country to support this densification project.

- ***Set-up of a dedicated WEB-site***

  The role of the geoid in the surveying practice becoming more and more important, as it is considered a basic tool in GPS-heighting works. In contrary to this tendency the geoid is fairly under-represented on the Internet.

  The IGGC ESc has the intention to establish an official WEB-site, which may includes official information on organizational issues and details on the present EGG97 solution and our future plans. This site will be linked to the IGGC and IGeS sites.

  The IGGC ESc asks all national representatives to do efforts for the establishment and/or improvement of national or institutional WEB-sites dedicated for geoid AND to support with ideas the design and establishment of an attractive ESc WEB page.

- ***Completion of a geoid and gravimetric meta-database***

  Beside the EGG97 regional solution, all ESc member country had computed national geoid solutions. We may get information on these solutions only occasionally in meetings and conferences, where they are presented. In order to support the better information of our community the set-up of a meta database would be desirable. This database would contain only some basic information (computation method, grid resolution, estimated accuracy, data used, point of contact,...etc.). Browsing this database any interested person could get information easily and could contact the local representative for more details. Similar meta-

database would be extremely important for the gravimetric data sets. The IGeS has already installed a WEB-based geoid repository (www.iges.polimi.it) . We should discuss with IGeS to find an optimal solution for sharing information and clearly separating the tasks.
The IGGC ESc asks all national representatives to support this idea and to provide the necessary information. A sample Questionnaire is enclosed to this report, any change and amendment to the sheet is highly welcome.

Budapest, 25 July 2000.

Ambrus Kenyeres
President of the IGGC
European Subcommission

QUESTIONNAIRE

COUNTRY : ....

REPORT PREPARED BY : ....

INSTITUTE : ....

....

GEOID ACRONYM : ....

AVAILABILITY : CLASSIFIED ☐ COMMERCIAL ☐ FREE ☐

TYPE : GRAVIMETRIC ☐ OTHER ☐ ....

GEOID GRID RESOLUTION : ....

REFERENCE ELLIPSOID : ....

DATA USED :

GRAVITY : GRID RESOLUTION : ....

REFERENCE SYSTEM :...

ESTIMATED ACCURACY:..

GEOPONTENTIAL MODEL : DEGREE : ....

DTM : GRID RESOLUTION :

GPS/LEVELLING DATA

ASTRONOMIC MEASUREMENTS

OTHER

COMPUTATIONAL METHOD :

FFT ☐ NUMINT ☐ COLLO ☐ OTHER ☐

ESTIMATED ACCURACY :

AVAILABILITY OF GPS/LEVELLING DATA

NO. OF POINTS : ....

ESTIMATED ACCURACY OF GPS ELLIPSOIDAL HEIGHTS: ....

REFERENCE SYSTEM: ....

ESTIMATED ACCURACY OF LEVELLED HEIGHTS: ....

REFERENCE SYSTEM: ....

PART III

CONTRIBUTING PAPER

DETECTION AND CORRECTION OF SYSTEMATIC ERRORS ON GRAVITY DATA SETS

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A color version of this posetr is available on the BGI website (http://bgi.cnes.fr)

The need of better and better accuracy for geodetic applications is synonimous of improving the gravity data validation techniques. The gravity datasets are often heterogeneous in what concerns the position and elevation determinations, the reference datums, the gravimeter accuracy, the reduction formulas and the applied corrections. The information about the coordinates datum is often lacking or incomplete.

Isolated errors (digitization error on g, elevation or position) can be easily identified, using collocation techniques - to predict the anomaly at a given station using the neighbouring ones - with mapping of anomalies based on triangulation. The complete Bouguer anomaly must be used, which implies to have an accurate DTM.

Systematic errors are trickier to identify and those related to the g value and the applied corrections introduce a bias in the geoid height computed from free air anomalies.

Error	Impact	Identification
Gravity reference station : erroneous g value Ex : Postdam g value	g, gravity anomalies	Intercomparison between overlapping surveys
Reference ellipsoid error =f(latitude)	Gravity anomalies	id
XY datum	Latitude, longitude, anomalies	Comparison with DTM Comparison of stations coordinates with digitized maps or orthophotos
Height datum	Height, anomalies	Comparison with DTM

First technique : comparison with DTM

A least squares method has been implemented to minimize the differences between observed heights and the ones interpolated from the DTM grid applying Δx and Δy to the stations coordinates. Synthetic tests for relatively flat areas or for ruggosity ones show a good stability of the method (fig.1) and allow an accurate determination of horizontal and vertical coordinates biases, if we suppose these ones to be constant on the survey area.

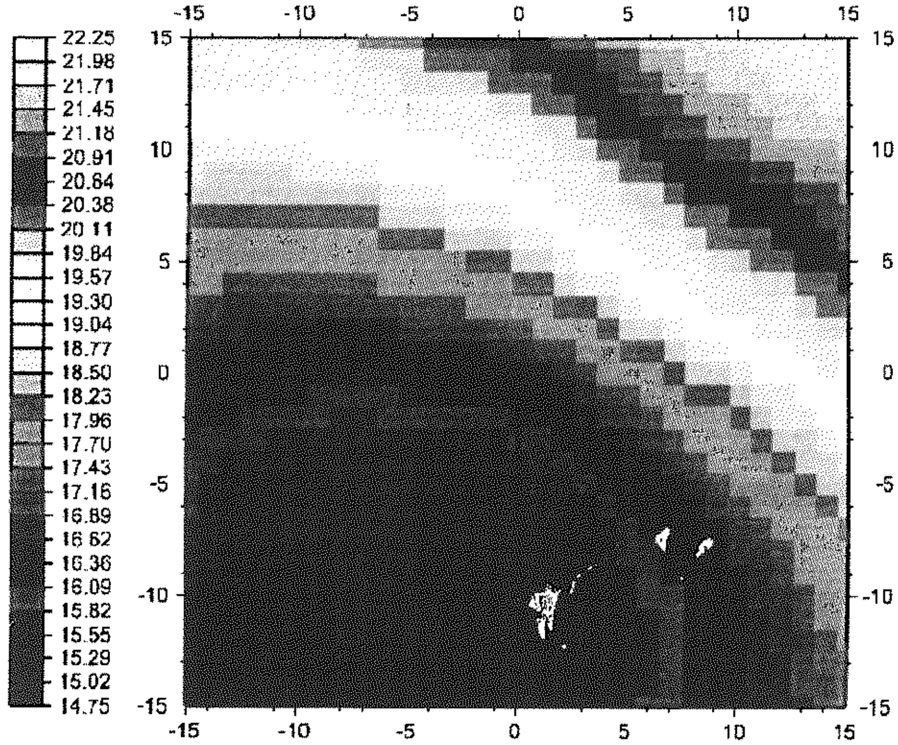

Fig.1: Map of the sum of the differences between the station heights and the DTM, for Δx and Δy

Most of the french gravity surveys (fig.2a) have been obtained during the last fifty years. Different coordinates systems have been used: conical projections with different parameters, or local cadastral coordinates. For each survey, we compared the stations coordinates with a of 100 x 120 meter resolution DTM, refered to the NTF datum (fig.2b). The maximum difference (~1km) was observed for a survey in Alsace (source nr.35100075), where a local datum has been used, a conversion error can probably explain such a large discrepancy. Fig.3a & 3b show the decrease of the heigth differences between the stations and the DTM after applying the coordinates corrections. We have superimposed on a 1 :25000 scale topographic map the stations without corrections (fig.4a) and with corrections (fig.4b). In this last case, the gravimetric lines are well associated with roads and tracks.
Satellite images offer also a way to control the position of the gravity stations and to detect possible biases, the surveys being the more often established along communication lines (fig.5).

Second technique : intercomparison between overlapping surveys
The Bouguer anomaly, less correlated with the the topography, is predicted, using a collocation technique, at the stations of a given survey, using selected surveys ; the differences between the observed and the predicted values and their associated errors are plotted. A simpler technique can also be used, plotting the difference between the Bouguer anomaly at a point and the one at its nearest neighbour as a function of the distance between the two points : if the sources have the same gravity datum, we observe a cone distribution (fig.6a)), if a source is biased, the bias can be estimated (fig.6b).

These different techniques show that the intercomparisons with DTM or gravity data allow to identify systematic errors and to correct them, but with the need of anaccurate DTM (<=100 m grids). This could be obtained with the delivery of products issued from the SRTM mission.

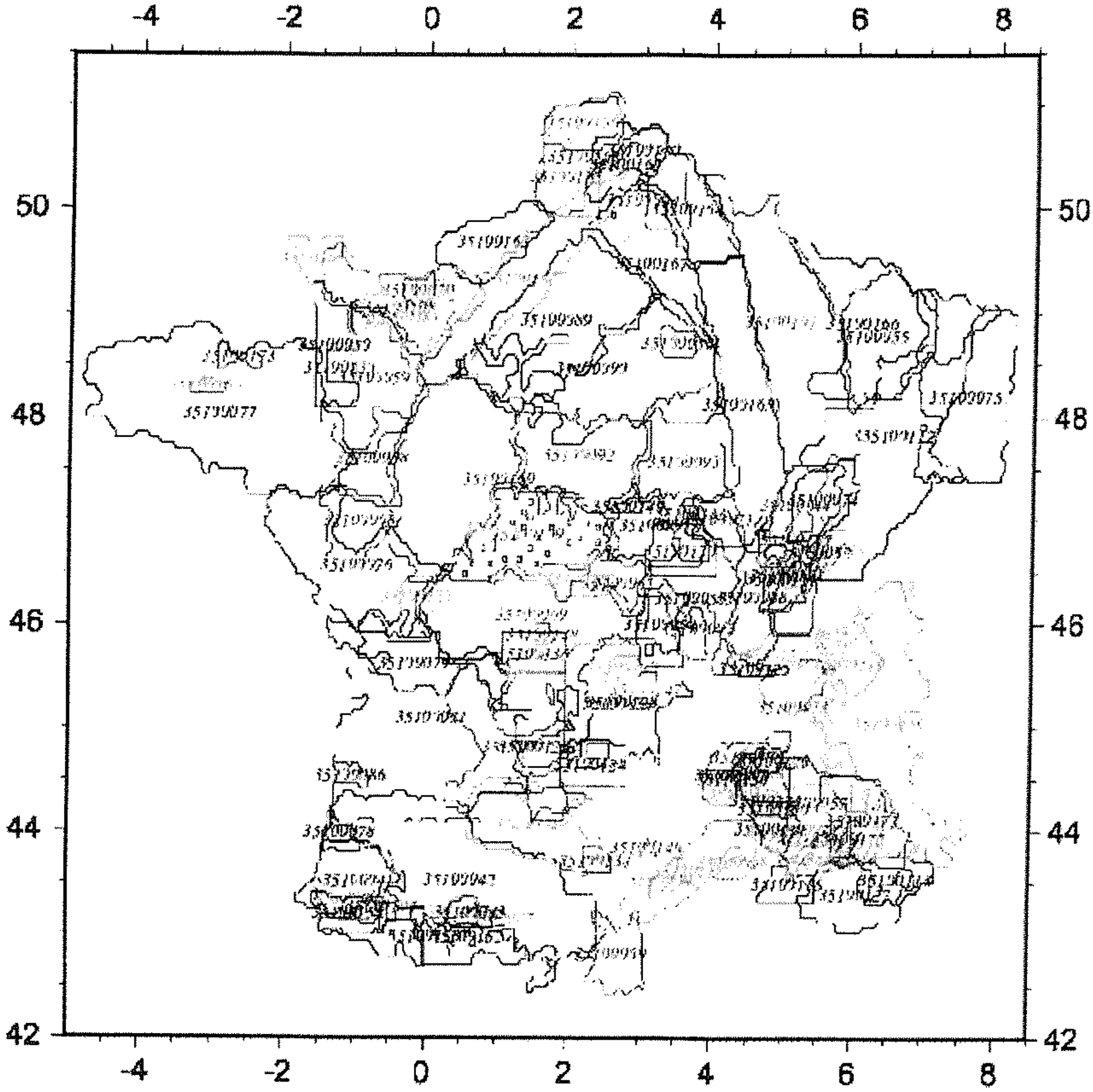

Fig.2a: Coverage of the gravity surveys

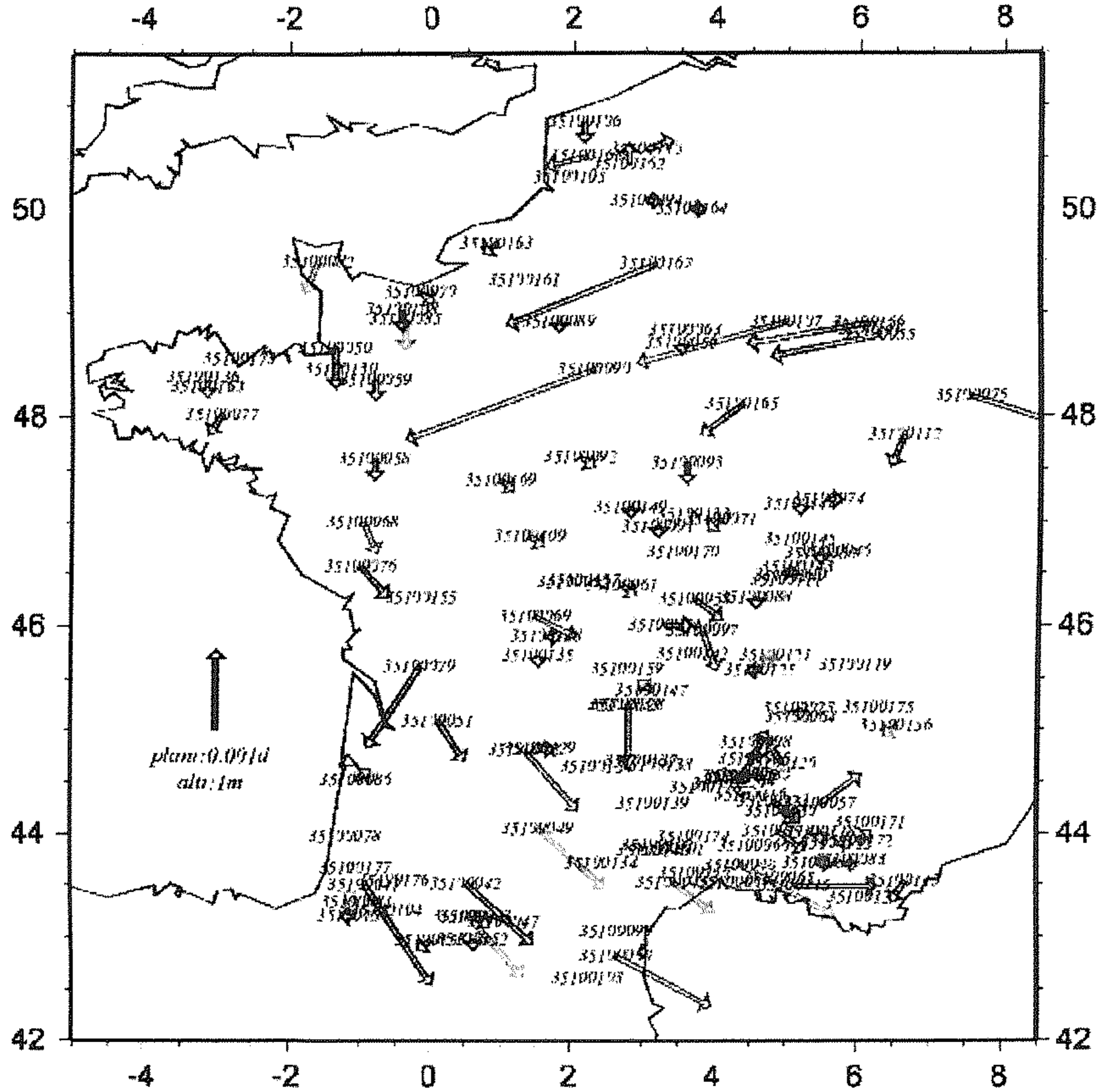

Fig.2b : Biases of the gravity surveys/NTF datum, estimated using a 100x120m DTM

Fig.3a: Differences between the station heights and the DTM before adjustment of Δx and Δy.

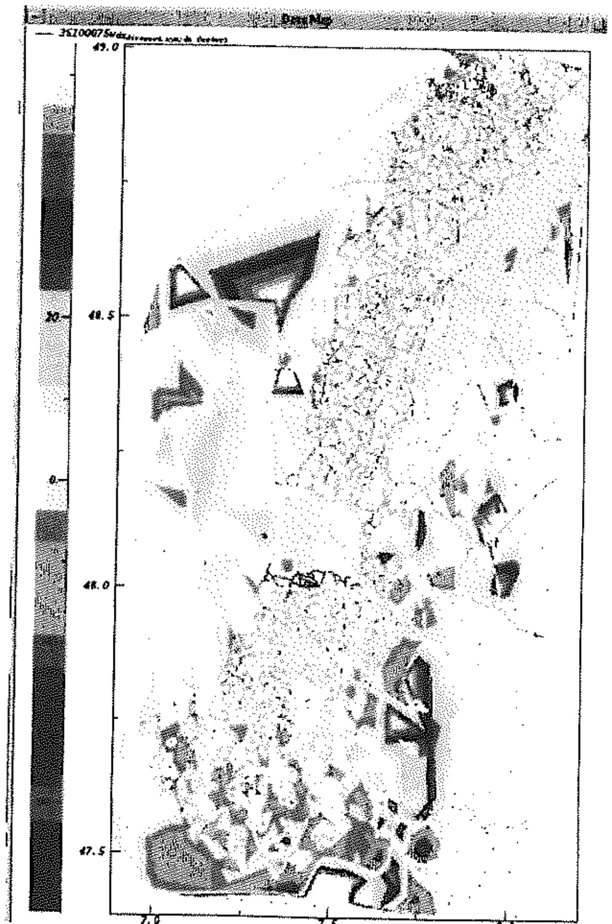

Fig.3b: Differences between the station heights and the DTM after adjustment of Δx and Δy.

Fig.4a: Position (cross) of the gravity stations (source 3.510.007) before applying coordinates corrections
1/25000 scale topographic map

Fig.4b: Position (cross) of the gravity stations (source 3.510.007) after applying coordinates corrections

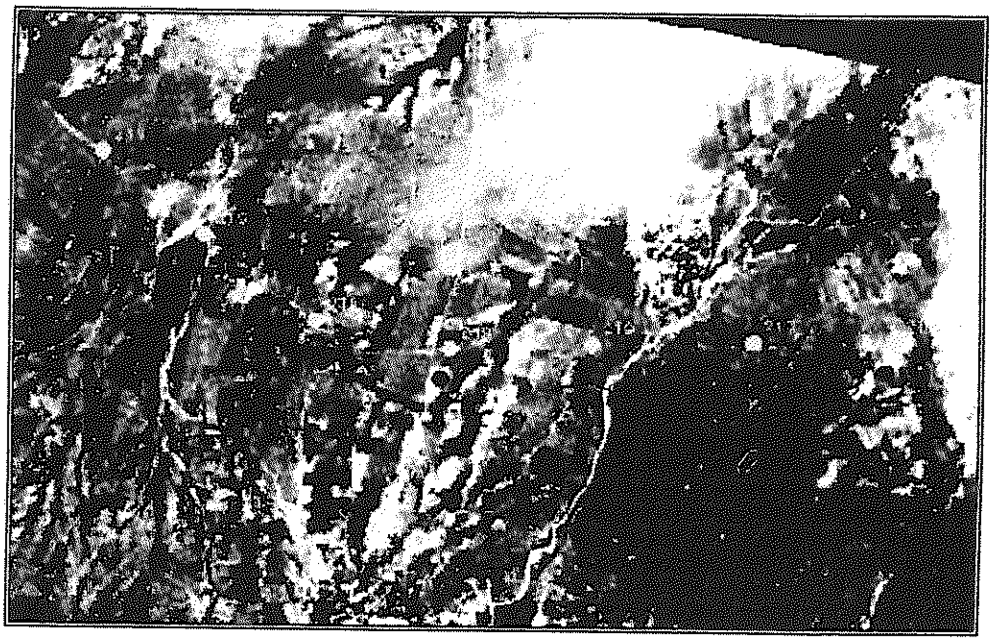

Fig.5: Spot corrected image (1 pixel = 10 m) referenced to GRS80 ellipsoid
Gravity survey : yellow pts originally referenced to local datum, shifted ~160 m./ tracks,
■ points referenced to GRS80, well correlated with two tracks

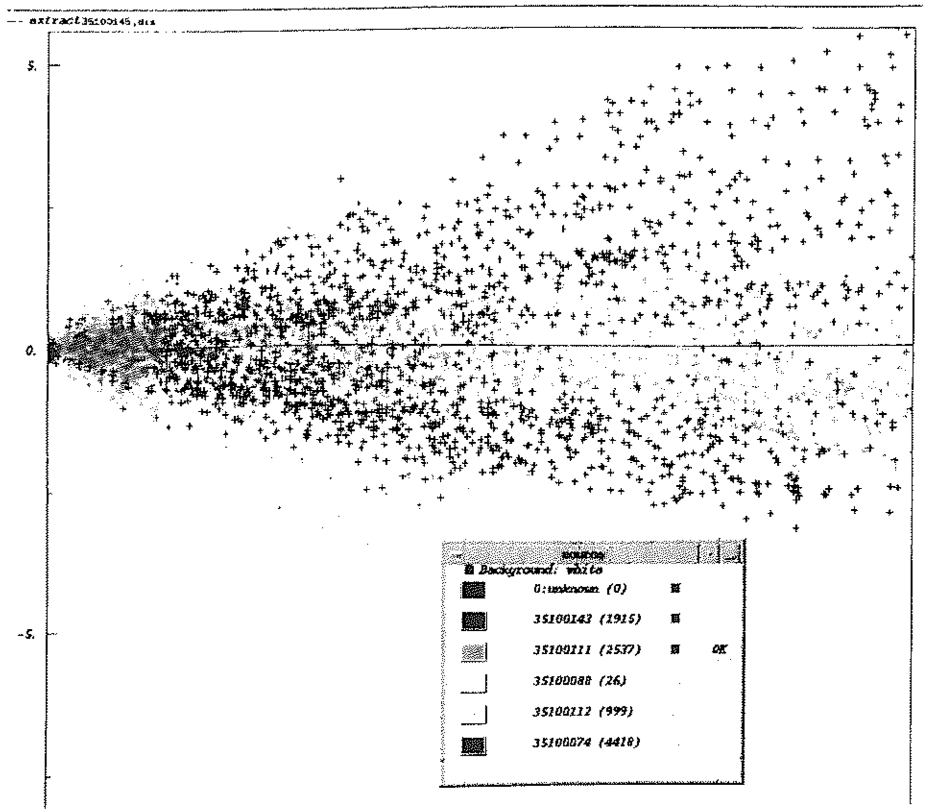

Fig.6a: Comparison of the survey no.3.510.145 with the surveys no.3.510.143 & 3.510.111
Good agreement

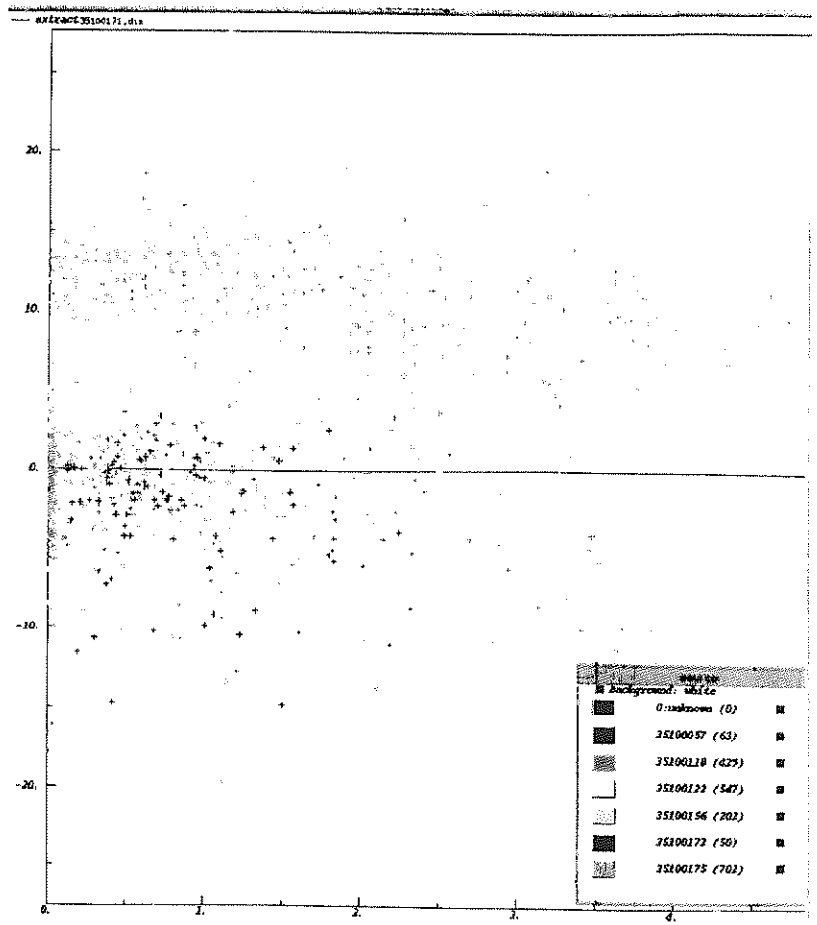

Fig.6b: Comparison of the survey no.3.510.171 with the survey no. 3.510.175
Bias between these two surveys, problems with the other ces.sour