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Results of the Sixth International Comparison of Absolute Gravimeters

ICAG-2001

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Abstract. The Sixth International Comparison of Absolute Gravimeters was held from 2 July to 28 August 2001 at the Bureau International des Poids et Mesures, Sèvres. Seventeen absolute gravimeters were used to make measurements at five sites of the BIPM gravity network. The vertical gravity gradients at the sites and the ties between them were also measured using seventeen relative gravimeters. For the first time the ties between the sites of the gravity network of the BIPM were also measured using the absolute gravimeters. Various methods of processing of the absolute and relative data were tested to calculate the results.

The final results of the ICAG-2001 are presented. The acceleration at a height of 0.90 m at sites A and B is given as (980925701.2 ± 5.5) µGal and (980928018.8 ± 5.5) µGal, respectively, calculated using a combined adjustment of the absolute and relative data.

1. Introduction

The Sixth International Comparison of Absolute Gravimeters, ICAG-2001, continues the series of such comparisons started in 1981 [1-10]. All the ICAGs have been organized jointly by the BIPM and Working Group 6 (Comparison of Absolute Gravimeters) of the International Gravity and Geoid Commission (IGGC). Like the previous comparisons, ICAG-2001 was held at the BIPM (Sèvres, France). Seventeen absolute gravimeters (AGs), from twelve countries and the BIPM, and seventeen relative gravimeters (RGs) from eight countries were used during the comparison, which ran from June to August 2001 and (for the IMGC group) from 27 September to 2 October 2001.

To allow all the measurements to be made within this relatively short time period, the BIPM has constructed an additional site for *g*-measurements in its new building, Pavillon du Mail. Seven sites of the BIPM gravity network were used for the relative measurements and five for the absolute measurements.

New measurement and data-processing strategies were used in the ICAG-2001 as a consequence of the changing role of absolute gravimeters [11], which become the primary standards in gravimetry in place of the traditional gravity networks. The number of absolute gravimeters is increasing, and the ties of the networks can now be measured using the AG alone. It is of importance to realize in practice the current level of accuracy of such kinds of the measurements. The potential accuracy of ballistic absolute gravimeters is estimated in various publications (see, for instance, [12]) but only the ICAGs provide an opportunity to compare the measurements of the ties using numerous relative and absolute gravimeters. During the ICAG-2001 the ties between the sites of the BIPM gravity network were measured using not only the RGs as during the previous comparisons but also for the first time using the AGs.

Two different kinds of observation equation were used for the adjustment of the relative data. The first was based on the readings of the relative gravimeters [8,10], and the second used the differences between these readings [13].

Using the AGs to measure the ties between the sites also made it possible to adjust the measured absolute *g*-values, as well as to make a combined adjustment of all the results of the relative and absolute measurements. This combined adjustment yields both the *g*-values at the sites, which are of importance for long-term analysis of the variations of the gravity field at the BIPM gravity network, and an estimate of the uncertainty of the measurements.

The use of various approaches for the data processing improves understanding of the analysis of the absolute and relative results and provides a basis for the choice of data-processing method to be used in future gravimeter comparisons. Such details might be included in the technical protocol of a future comparison, to bring under regulation its organization, the measurement strategy, the method of data processing and the way to represent the results of the comparison.

2. BIPM gravity network

The construction at the BIPM of a new building, the Pavillon du Mail, made it possible to extend the gravity network by creating a number of new sites for *g*-measurements. The foundation for the new sites (B, B1, B2, B3, B4 and B5) is a concrete block with a mass of about 60 tonnes and dimensions 6.0 m (length) × 4.0 m (width) × 1.5 m (depth). The top surface of the foundation is levelled to the floor to minimize inhomogeneity of the gravity field. This construction differs from that of the pillars of the sites A and A2, which have a height of about 2.4 m above floor level in the basement. To improve isolation from microseismic vibrations the new foundation is installed on pads of an elastic material inserted between its lower surface and the bottom of the hole in the concrete basement. No metal reinforcing bars were used in the construction of this foundation. The distribution of the sites is shown in Figure 1. Details 1a, 1b and 1c show the locations of the measurement points at each site. The foundation in the laser building (see Figure 1a) is a concrete block approximately 30 cm thick, lying on a sand-bed.

Sites A, A2, L3, L4, B, B1 and B3 were used for the relative *g*-measurements and sites A, A2, B, B1 and B3 for the absolute measurements. The *g*-values at these sites vary by up to 2.7 mGal at floor level. With respect to previous ICAGs this improves the capability to check and monitor the calibration parameters of the relative gravimeters and their feedback systems.

During the comparisons in 1994 and 1997 it was found that the sites of the BIPM’s outdoor calibration line suffer the poor environmental conditions (high level of microseismic noise, etc.). During the ICAG-2001 this calibration line was not used.

Site B3 was used for almost continuous monitoring of the gravity field during the principal period of absolute *g*-measurements, from 30 June to 3 August 2001, using the BIPM absolute gravimeter FG5-108.

The levelling of the sites A, A2, B, B1, B2, B3, B4, L3 and L4 was carried out in June 2001 by the Bureau de Recherche Géologiques et Minières (BRGM), France (N. Debeglia, F. Dupont).

3. Participants in the ICAG-2001

The participants in the ICAG-2001 are listed with their absolute gravimeters in Table 1. The absolute gravimeters may be classified into four main groups: JILA-type gravimeters, FG5-type gravimeters, the A10 gravimeter and the IMGC gravimeter. The FG5 group may be split into at least three subdivisions which differ in composition (dropper mechanism, length of free-fall path of the test body, laser interferometer unit, the use of a fibre-coupled or incorporated laser, modifications of the electronic units, software, etc.). Only the IMGC gravimeter is of a rise-fall type. The relative gravimeters were of three main types: LaCoste-Romberg (LCR), Scintrex (CGM) and Sodin.

Table 1. Participants in the ICAG-2001 and their gravimeters.

Country	Institution	Absolute Gravimeter(s)	Relative gravimeter(s)	Participation in the ICAG-97
Austria	Bundesamt für Eich- und Vermessungswesen (BEV), Vienna	JILAg-6	LCR-D51	JILAg-6
Austria	Institute für Meteorologie and Geophysik (IMG), Universität Wien, Vienna	–	LCR-G625	LCR-D009 LCR-G625
Belgium	Observatoire Royal de Belgique (ORB), Brussels	FG5-202	LCR-G206, Scintrex-256	FG5-202, LCR-G487
Canada	Natural Resources Canada (NRCan), Ottawa	JILA-2, A10-003	–	JILA-2, LCR-D006 LCR-D028
Finland	Finnish Geodetic Institute, (FGI), Masala	JILAg-5		JILAg-5
France	Bureau de Recherches Géologiques et Minièrs (BRGM), Orléans	–	Scintrex-245	–
France	Institut de Recherche pour le Dévelopment (IRD), Bondy, Institut de Physique du Globe de Paris (IPGP), Paris, Ecole Nationale des Sciences Géographiques (ENSG), Marne-la-Vallée	–	Scintrex-136, Scintrex-193, Scintrex-323	Scintrex-136, Scintrex-193
France	Insitut Géographique National (IGN), Saint-Mandé	–	Scintrex-408, Scintrex-379	–
France	École et Observatoire des Sciences de la Terre (EOST), Strasbourg	FG5-206	–	FG5-206
Germany	Bundesamt für Kartographie und Geodäsie (BKG), Frankfurt	FG5-101, FG5-301, A10-b002	–	FG5-101, LCR-D0211
Germany	Institute für Erdmessung (IfE), Universität Hannover, Hannover	–	LCR-G079, LCR-G368, LCR-G709	LCR-G298, LCR-G709
Italy	Istituto di Metrologia "G. Colonetti" (IMGC), Turin	IMGC	–	IMGC
Japan	National Metrology Institute of Japan, National Institute of Advanced Industrial Science and Technology (NMIJ/AIST), Tsukuba	FG5-213	–	–
Czech Republic	Geophysical Institute AS CR (GI ASCR), Prague	–	LCR-D188	–
Russia	Sternberg Asronomical Institute of Moscow State University (SAI MSU), Moscow	–	Sodin-212	–
Spain	Instituto Geográfico Nacional (IGN), Madrid	FG5-211	–	–
Switzerland	Swiss Federal Office of Metrology and Accreditation (METAS), Bern-Wabern	Fg5-209	Scintrex-494	–
UK	National Physical Laboratory (NPL), Teddington	FG5-105	–	FG5-103
UK	Proudman Oceanographic Laboratory (POL), Bidston	FG5-103	–	FG5-103
USA	National Institute of Standards and Technologies (NIST), Gaithersburg	FG5-204	–	FG5-204
	Bureau International des Poids et Mesures (BIPM), Sèvres	FG5-108	LCR-G336, belonging to ORB	FG5-108

4. Relative gravimetry campaign and data processing

On the basis of the experience gained in the previous comparisons, and considering the increasing number of absolute gravimeters world wide and their emerging role as primary standards in gravimetery, a joint meeting of the ICAG-2001 steering committee and Working Groups 6 and 8 of the IGGC defined the following goals for the comparison:

- Establish an updated gravimetric network at the BIPM.
- Determine absolute *g*-values with accurate gravity differences and gravity gradient values.
- Investigate the relative gravimeters LaCoste-Romberg, Scintrex and Sodin.
- Study the local gravity field (*g*-values and gravity gradients) over the gravity network of the BIPM.
- Establish a data-evaluation procedure for the ICAGs.

In this section only a brief review of the organization, measurements, principles of data processing and most important numerical results of the relative *g*-measurements during the ICAG-2001 are presented. A detailed analysis of the relative campaign will be published elsewhere in a dedicated paper. General discussions, related to the previous comparisons, on the relative *g*-measurements required for the determination of *g*-value differences between pillars (network ties) and vertical gravity gradients above the pillars, can be found in [1-4, 6, 8, 10].

4.1 *Relative g-measurements*

Measurements of the network ties and the gradients at each site were made separately. The height of the gravity field sensor of the relative gravimeter was brought close to the reference heights (listed below). For the network determination each gravimeter measured three loops, defined as a continuous sequence of measurements. The loops were established such that each yielded at least one direct tie between any pair of sites of the network. The various points were measured at quasi-equal time intervals so that the measurement accuracy was homogeneous and control of the zero-drift of the gravimeters was facilitated. Five loops with fixed tie configurations were proposed. Figure 2 shows loop 1 (sites L4, B1, B, L4, A, B, A2, A, L3, A2, L4, L3, B1, A, A2, B1, B, L3).

In order to reduce the gradient correction error in the absolute measurements, the network was defined and measured at a height of 0.9 m above ground. This height was measured relative to a benchmark defined by a cross engraved on the cover plug over the aluminium disk installed at each site. The total thickness of the disk including its plug is 12 mm. The height of 0.9 m is an intermediate reference height for absolute *g*-measurements; it is consistent with that chosen for the previous comparisons and corresponds approximately to the average height of attribution of *g*-value for the absolute gravimeters.

The vertical gravity gradients, which are known to be non-linear at the sites of the BIPM network, were determined by relative *g*-measurements at heights of 0.05 m (LCR only), 0.30 m, 0.90 m and 1.30 m. The introduction of measurements at 0.30 m was proposed to improve the link between the CGM and LCR data; these gravimeters have different sensor heights: that of the CGM is approximately 0.26 m while that of the LCR is only about 0.05 m in its standard configuration. Five sets of tripods were constructed at the BIPM to realize the necessary heights with the various types of gravimeter. Each set consists of tripods with heights of 0.25 m, 0.40 m and 0.60 m, which in different combinations, can form towers (supports) of all the required heights. Figure 3 shows the set of tripods and the support assembled to hold the CGM sensor at a height of 1.30 m above floor level. The new supports and the additional height level improved the accuracy of the measurements of the vertical gravity gradients. Loops for gradient determinations with at least three relative measurements at each height were proposed in a similar way to that for the network tie measurements.

The majority of the relative measurements were carried out from 5 to 8 June and from 18 to 23 June 2001, with some complementary measurements made in July 2001. In total seventeen relative gravimeters from fourteen institutes and eight countries took part. About 2000 measurements (or occupations, as the gravimetrists call them) were performed. For the first time in the ICAG's history, CGM gravimeters dominated the relative measurements.

4.2 *Data processing*

Data processing was carried out following the standard procedure for high-precision gravimetry [2]. Pre-processing included the calculation of corrections for Earth tides and the differences of the sensor heights from the nominal reference height at each point, and the conversion of the gravimeter readings to *g*-values in milligals using the owner-supplied scale factors. Tidal corrections included the observed tidal factors as given in the database of the International Centre for Earth Tides (ICET) [9].

The corrected readings were used as the input data for two independent adjustment procedures. The first adjustment procedure was developed by M. Becker [8] and uses the model based on the gravimeter readings. This approach was used to process the relative data in all previous ICAGs. The second approach was developed at the BIPM by Z. Jiang [13] and uses the gravity difference based model. This approach was originally developed for the adjustment of the China Gravity Base Net

1985 System and uses the “adjG” software modified and adopted to the ICAG-2001 gravity network.

4.2.1 *Observation equations for the adjustment*

As this is the first time the “adjG” software has been used to process ICAG data, the observation equations and principles of the adjustment are summarized here. Detailed discussion of the mathematical models can be found in [13].

The observation equations for the relative measurements are obtained to adjust the differences of the gravimeter readings, omitting periodic as in the case of the ICAGs. The observation equations for the *g*-value differences can be written as follows:

$$v_{i,j} = \sum_{k=1}^{P_k} E_k (z_j^k - z_i^k) - (\overline{g}_j - \overline{g}_i), \qquad (1)$$

with the weights $w_{i,j}$, where

$w_{i,j}$: weight of the adjusted *g*-value difference between points *i* and *j*. For relative gravimeters the weight is firstly pre-determined using analysis of the zero-drift behaviour of the closure measurements in the loop and, if necessary, modified for each g-value difference based on its residuals in the pre-adjustment. For absolute gravimeters the weight depends on their individual uncertainty and the gradient correction error.

$v_{i,j}$: residual of the adjusted *g*-value difference between points *i* and *j*.

$\overline{g}_i, \overline{g}_j$: adjusted *g*-values at points *i* and *j*.

z_i, z_j : zero-drift-corrected readings of the relative gravimeter at points *i* and *j*, or *g*-values measured using the absolute gravimeter.

E_k: polynomial coefficients of degree *k* of the gravimeter scale function. $E_k = 1$ with $k = 1$ for absolute *g* measurements.

The observation equations may be used for both relative and absolute measurements if the latter were performed at at least two points within a time interval during which the parameters and offsets of the absolute gravimeter remain stable. The unknowns, such as the gravity values and the parameters of the scale functions, are determined by the least-squares (LS) method of minimizing the residuals based on the observation equations; this also provides estimates of the mean square erorrs for all determined unknowns.

The zero-drift corrections for the relative gravimeters were applied in the pre-processing stage, whereas in the alternative adjustment according to [8] the drift determination was included in the adjustment as a whole. A polynomial model was used to estimate the zero-drift within a loop measured within about five hours. A network loop gives about nineteen closure measurements. For the LCR and CGM gravimeters the gradient loops give thirteen and ten closure measurements, respectively. The software auto-detects the required order of zero-drift polynomial from the ratio of the closure number divided by five (because at least five observations are required to determine an unknown polynomial coefficient in order to obtain a reasonable correction for zero-drift).

A polynomial of at most third order and at least first order was determined by least-squares pre-adjustment. In the case of zero-drift jumps or discontinuities the loop to be processed was cut into two sub-loops and zero-drifts were calculated separately. The mean square error of such zero-drift-free gravity readings varied from 1 μGal to 2 μGal for the gradient measurements and from 2 μGal to 5 μGal for the network measurements, for both the quartz-spring Scintrex and metal-spring LCR gravimeters.

The observation equation for g-values (or a single corrected absolute gravity observation) is:

$$v_i = z_i - g_i + \delta_k , \qquad (2)$$

with the weights w_i, where

$\bar{g}_i$: adjusted g-value at point i.

δ_k : offset of the k-th gravimeter.

The offsets of those absolute gravimeters with larger residuals were determined in test computations. However, it was decided that for the ICAG-2001 the offsets of the absolute gravimeters would not be taken into account, in order to better reveal any discrepancies between the absolute measurements. For the combined adjustment of the results of the absolute and relative measurements, both g-values and their differences were used.

In the calculation of the vertical gravity gradient correction we assume that the gravity field over the sites may be represented by a second-order polynomial function of the height h above the benchmark:

$$g(h) = c_0 + c_1 h + c_2 h^2 , \qquad (3)$$

where c_0, c_1 and c_2 are the coefficients of the polynomial representing the function $g(h)$.

Polynomial coefficients for each site are obtained using a LS minimization. A gradient correction δ_g of g-value from the height h_0 to h is given by

$$\delta_g = g(h) - g(h_0) = c_1 (h - h_0) + c_2 (h^2 - h_0^2). \qquad (4)$$

A gradient correction is used to transfer the relative gravimeter readings from the sensor height to the height h_0 (0.05 m, 0.30 m, 0.60 m, 0.90 m or 1.30 m) and to transfer the g-values measured using the absolute gravimeters from the height of the observations (the heighest point of the path of the falling test body) to the standard network height of 0.90 m.

4.2.2 *Weighting of measurement results*

The weight of the result of each measurement is given by

$$w_i = \frac{\mu^2}{M_i^2}, \qquad (5)$$

where M_i is the mean square error of the measurement and $\mu = 4.5$ μGal is the a priori unit weight mean square error, chosen to be matched the assumed combined error of an absolute gravity measurement:

$$\mu^2 = \overline{m}^2_{\text{gradient}} + \overline{m}^2_{\text{abs}} + \overline{m}^2_{\text{sys}}, \qquad (6)$$

where

$\overline{m}_{\text{gradient}} = 0.5$ μGal is the average gradient correction error [13],

$\overline{m}_{\text{abs}} = 2.0$ μGal is the average standard deviation of the absolute gravity measurements (except some of the data of the A10-003 gravimeter, see Table 5),

$\overline{m}_{\text{sys}} = 4.0$ μGal is the average systematic error of the absolute measurements (determined iteratively after the adjustment of (i) only the absolute data and (ii) combined adjustment of the relative and absolute data).

Results lying outside three times the mean standard deviation of the residuals (differences between the mean and measured values) were rejected.

4.2.2.1 *Weights for g-value differences*

The weights for the gravity differences of the observation equation (1) are given by the formula

$$w_{i,j}^2 = \frac{\mu^2}{M_{i,j}^2}, \qquad (7)$$

where $M_{i,j}$ is the mean square error of the corresponding gravity differences. There are two cases:

(a) For relative gravimeters, $M_{i,j}$ is estimated from the zero-drift calculation and is therefore common to all the gravimeters within a particular loop. The corresponding weight $w_{i,j}$ should lie within the limits $w_{\min} \le w_{i,j} \le w_{\max}$, chosen to be $w_{\min} = 0.1$ and $w_{\max} = 4$. An upper limit $w_{\max}$ is entered to avoid the domination of any one of gravimeters and a lower limit $w_{\min}$ allows all the gravimeters to be presented. The upper limit, $w_{\max}$, was determined such that $nw_{\max}$, where n is the total number of observations, is equal to half the total weight of the relative observations. It can be shown that in this way $w_{\max}$ provides optimal reliability to the ensemble average in which the number of outlying observations (those lying outside three times the standard deviations of the residuals) is minimal.

(b) For the absolute gravimeters

$$M_{i,j}^2 = m_{\text{abs},i}^2 + m_{\text{abs},j}^2 + 2\overline{m}_{\text{gradient}}^2, \qquad (8)$$

where $m_{\text{abs},i}$ and $m_{\text{abs},j}$ are the standard deviations of the g-values measured using the absolute gravimeters at points i and j.

4.2.2.2 *Weights for g-values*

The weight of the measured absolute g-value corresponding to (2) is given by

$$w_{\text{abs},i} = \frac{\mu^2}{M_i^2}, \qquad (9)$$

where $M_i^2 = m_{\text{abs},i}^2 + \overline{m}_{\text{gradient}}^2 + \overline{m}_{sys}^2$.

Here the limit $w_{\min}$ = 0.01 was chosen to reduce the contribution of those measurements with large residuals, and no assignment of $w_{\max}$ was necessary because the weights of all the results of absolute measurements were similar and no over-weight of a particular gravimeter was expected.

4.2.3 *Results of the adjustment*

Test computations to optimize the data-processing strategy were performed taking into consideration

- accuracy, weighting of the data, discrepancies, and systematic errors and offsets of the absolute measurements;
- accuracy, weighting of the data, discrepancies and scale calibrations of the relative gravimeters;
- outlying data and data rejections;
- gradient corrections.

Based on these parameters different adjustments were performed as follows.

1. Adjustment of the results of only the relative measurements. This is an unconstrained network adjustment with fixed point A, either with or without the use of owner-supplied scales. Some well-known calibration baselines, such as the Paris-Orleans absolute baseline and the Hanover vertical baseline [14], were indirectly introduced in the tests.
2. Adjustment of only the absolute measurement data.
3. Combined adjustment of both relative and absolute data.

Vertical gravity gradients above each site were approximated using a second-order polynomial based on the results of adjustment 1.

Adjustments were made using two models, one proposed by M. Becker [8,10] and the other by Z. Jiang [13]. Theoretically, both models should result in the same g-values calculated from a common data set, assuming an adequate model for the gravimeter drift, tares and interruptions as well as for the convergence of the iterative weight determination of each measurement. In practice, however, the results of the different adjustment models differ slightly due to differences in outlier rejection levels, drift and tare models as well as final determination of the weights. Tests showed that the discrepancies between the two models are not greater than 1.1 μGal. For the final evaluation of the ICAG-2001 data it was decided to accept the differences between two independent solutions when they became less than the uncertainties of the estimated parameters. At this point the iteration in the data cleaning and model refinement was stopped.

Finally the latter model [13] was used for the data analysis and calculation of the final results of the ICAG-2001.

4.2.3.1 *Adjustment of the relative measurement data*

Although all the participating relative gravimeters were supposedly calibrated, a uniform scale for the relative networks was introduced implicitly during the adjustment by fixing the scales of the gravimeters G709 and G79. These gravimeters belong to the Hanover University and were calibrated on the Hanover calibration system immediately after the relative measurements of the ICAG-2001.

The results of the adjustment of so-scaled relative data based on g-value differences are presented in Table 2.

Table 2. Final results of relative measurements during the ICAG-2001 (expressed in microgals after the subtraction of the reference value g_r = 980920000 μGal). m is the mean-square error of the adjusted g-value relative to the fixed during the adjustment g-value at the point A.090. The points are described by the site name and the height of the measurement in centimetres, i.e. A2.030 corresponds to point A2 at a height 0.3 m.

No.	Point	Adjusted g-values/ μGal	m/ μGal	No.	Point	Adjusted g-values/ μGal	m/ μGal
1	A.005	5968.2	0.7	15	B1.090	8015.6	0.7
2	A.030	5887.6	0.4	16	B1.130	7901.4	0.8
3	A.090	5701.2	0.0	17	B3.005	8259.7	1.2
4	A.130	5580.4	0.4	18	B3.030	8183.3	0.9
5	A2.005	5972.0	0.8	19	B3.090	8002.3	0.8
6	A2.030	5890.5	0.5	20	B3.130	7886.4	0.9
7	A2.090	5706.3	0.4	21	L3.005	6852.8	1.0
8	A2.130	5586.8	0.5	22	L3.030	6783.4	0.7
9	B.005	8273.4	1.0	23	L3.090	6618.7	0.5
10	B.030	8197.6	0.8	24	L3.130	6510.8	0.6
11	B.090	8019.3	0.7	25	L4.005	6868.2	1.1
12	B.130	7900.2	0.7	26	L4.030	6798.7	0.7
13	B1.005	8266.2	1.0	27	L4.090	6632.8	0.5
14	B1.030	8191.0	0.9	28	L4.130	6522.1	0.7

The coefficients of the polynomials (3) representing the gravity field over the sites are presented in Table 3.

Table 3. Polynomial coefficients (formula (3)) for the gravity field distributions over the sites and corresponding vertical gravity gradients γ at heights 0.9 m and 1.2 m.

	Coefficients			Gradients	
Site	c_0/ μGal	c_1/ μGal/m	c_2/ μGal/m^2	γ(0.9 m)/ μGal/m	γ(1.2 m)/ μGal/m
A	5.9847	–322.69	9.8	–305.1	–299.2
A2	5.9887	–324.14	12.7	–301.3	–293.7
B	8.2880	–300.81	2.1	–297.0	–281.5
B1	8.2801	–302.39	8.1	–287.8	–281.0
B3	8.2747	–310.70	9.0	–294.5	–289.1
L3	6.8670	–279.25	4.4	–273.3	–268.7
L4	6.8822	–276.51	0.1	–276.3	–276.3

5. Absolute measurements and data processing

A four-point gravity network (sites A, A2, B1, B3) was chosen for the absolute measurements, to allow the six ties between them to be measured at least five times. The gravity ties measured during the ICAG-2001 are shown in Figure 4.

The gravimeters FG5-213 (Japan) and FG5-204 (USA) used the electronic timing unit belonging to the BIPM because of some troubles with their own timing electronics. The interferometer unit and laser of the gravimeter JILAg-5 (Finland) were replaced during the measurements and the measurement data of this gravimeter were processed as the data from two different gravimeters JILAg-5/1 (at A and A2) and JILAg-5 (at B and B1).

The data of A10-b002 (BKG, Germany) were not presented by the participants for processing. The data of FG5-206 were presented only from one site, B.

The first stage of the absolute data processing was the data reprocessing using, when possible, the same software. The new g-software was used for most of the instruments except FG5-105 for which replay software 2.22 was used, FG5-108 (for which Unix version was used), FG5-213 (for which replay 3.14 was used) and JILAg-6, for which REPLAY - previous version of the Micro-g Solutions, Inc. software - was used. The algorithm in all versions is the same, but the format of the input data is different. For the IMGC and JILAg-5 (as well JILAg-5/1) the operators provided their data-processing results.

The drop data output by these free-fall gravimeters are the space intervals determined by means of laser interferometry, and the time intervals with respect to the start of the drop (or throw) of the free-falling test body. The free-fall acceleration is then estimated by fitting the parameters in the appropriate equation of motion to these sets of data. In general, 600 scaled fringes starting at 30 (see Table 4 for each gravimeter) were selected for the bulk of gravimeters in the fitting of the equation of motion to the data. A scaled fringe corresponds to $N(\lambda/2)$ where N is the fringe scale factor (specified, for instance, as 4000 in Micro-g Solutions, Inc. software OLIVIA) and λ is the nominal wavelength of the laser radiation. The start and stop fringes were selected based on the slight dependence of the resulting g-value. No system response correction was applied.

Correction for the speed of light was made using the retarded time scale

$$\tau_i = t_i - \frac{(x_i - x_0)}{c} \qquad (10)$$

and the equation of motion used was

$$x_i = x_0\left(1 + \frac{\gamma}{2}\tau^2\right) + v_0\left(\tau_i + \frac{\gamma}{6}\tau_i^3\right) + \frac{g_0}{2}\left(\tau_i^2 + \frac{\gamma}{12}\tau_i^4\right), \qquad (11)$$

where c is the speed of light, $(t_\mathrm{i}, x_\mathrm{i})$ are the time and position of the free-fall test body during a drop, γ is the vertical gravity gradient as measured with the relative gravimeters (at h = 1.2 m for the FG5 gravimeters and h = 0.9 m for the others), and the three unknowns are x_0 (initial position), v_0 (initial velocity) and g_0 (the g-value at the initial position). At this stage the gravity gradients calculated using the preliminary results of the relative g-measurements, presented in the circular letter of M. Becker of 15 August 2001, have been used. We did not include here the additional terms for the laser frequency modulation.

A correction of –0.003 µGal/Pa was applied to all the barometric pressure data. The barometers of the different gravimeters were compared against a BIPM pressure sensor: no individual corrections were applied because no standard calibration protocol existed. The tidal predictions were estimated using the observed tidal parameters for Sèvres, provided by the International Centre for Earth Tides (ICET) [9]. These observed parameters include solid Earth tides and attraction and loading effects from the ocean tides, obtained from an analysis of 292 days of data recorded from 6 May 1974 to 24 July 1977 using a LaCoste-Romberg spring gravimeter at the BIPM in Sèvres. The laser frequencies were measured by beat frequency measurements against one of the BIPM's reference He-Ne/I_2 lasers. The rubidium clocks frequencies were referred to a local caesium clock using an SRS620/1 frequency counter in frequency mode.

The absolute *g*-results of for all the gravimeters and all the sites are presented in Table 4.

Table 4. The results for all the absolute measurements during ICAG-2001 (expressed in microgals after subtraction of the reference value g_r = 980920000 μGal).

Date (2001)	Gravimeter	Site	#sets /#drops	Gradient μGal/cm	Z_{inst} /cm	Z_{ref} /cm	Z_{top} /cm	g at Z_{top} /μGal	u(set) /μGal	Fringes
1	2	3	4	5	6	7	8	9	10	11
7-8 Jul.	A10-003	A	180/25	–3.048	74.9	6.9	81.8	5690.7	33.1	120; 630
27-28 Jul.	FG5-101	A	9/150	–2.984	116.4	13.2	129.6	5580.8	0.8	30; 600
28 Jul.	FG5-101	A	12/150	–2.984	116.4	13.2	129.6	5580.4	0.9	30; 600
18-19 Jul.	FG5-103	A	18/200	–2.984	80.9	50.0	130.9	5580.7	0.8	30; 600
19-20 Jul.	FG5-103	A	24/200	–2.984	80.9	50.0	130.9	5580.7	1.2	30; 600
13-15 Jul.	FG5-105	A	78/100	–2.984	80.7	49.4	130.1	5578.0	1.1	2; 90
29 Jun.	FG5-108	A	24/100	–2.984	80.6	49.4	130.0	5585.5	1.1	1; 150
19-22 Aug.	FG5-108	A	142/100	–2.984	80.6	49.4	130.0	5585.4	1.3	1; 150
25-27 Aug.	FG5-108	A	96/100	–2.984	80.6	49.4	130.0	5585.8	1.3	1; 150
20-21 Jul.	FG5-202	A	40/100	–2.984	80.7	49.4	130.1	5581.3	1.1	30; 600
10-11 Jul.	FG5-204	A	22/100	–2.984	80.7	49.2	129.8	5577.1	5.8	30; 600
15-16 Jul.	FG5-204	A	24/100	–2.984	80.7	49.1	129.7	5575.7	1.4	30; 600
2-3 Jul.	FG5-206	A	25/100	–2.984	80.8	49.4	130.2	5585.2	0.9	1; 150
11-12 Jul	FG5-211	A	48/100	–2.984	116.4	13.3	129.7	5575.0	1.4	30; 600
12-13 Jul	FG5-211	A	32/100	–2.984	116.4	13.1	129.4	5575.6	1.3	30; 600
1-2 Aug.	FG5-213	A	15/100	–2.984	116.3	11.8	128.1	5586.4	1.3	30; 600
28-29 Jul.	FG5-301	A	22/150	–2.984	86.1	13.0	99.1	5670.3	1.6	30; 500
22-24 Jul	JILAg-5/1	A	127/25	–3.048	–6.5	91.3	84.8	5723.2	6.2	1; 150
4-5 Jul.	JILAg-6	A	14/175	–3.048	–5.5	97.8	92.3	5704.3	2.6	30; 600
5-6 Jul.	JILAg-6	A	18/175	–3.048	–5.5	97.8	92.3	5703.7	3.2	30; 600
	FG5-213	A1	20/100	–2.984	116.3	11.7	128.0	5571.5	0.8	30; 600
31 Jul – 1Aug	FG5-213	A1	14/100	–2.984	116.3	11.7	128.0	5571.0	0.8	30; 600
8 Jul.	A10-003	A2	50/25	–3.013	74.9	6.9	81.8	5684.6	22.1	120; 630
20-21 Jul.	FG5-103	A2	24/200	–2.933	80.9	49.8	130.7	5587.5	1.1	30; 600
21-22 Jul.	FG5-103	A2	20/200	–2.933	80.9	49.8	130.7	5589.0	1.0	30; 600
11-13 Jul.	FG5-105	A2	72/100	–2.933	80.7	49.2	129.9	5583.9	3.6	2; 90
14 Aug.	FG5-108	A2	22/100	–2.933	80.6	49.3	129.9	5593.2	1.0	1; 150
15 Aug.	FG5-108	A2	40/100	–2.933	80.6	49.3	129.9	5594.3	0.9	1; 150
16 Aug.	FG5-108	A2	26/100	–2.933	80.6	49.3	129.9	5594.2	1.2	1; 150
15-16 Jul.	FG5-202	A2	10/100	–2.933	80.7	49.2	129.9	5584.9	1.1	30; 600
16-17 Jul.	FG5-202	A2	24/100	–2.933	80.7	49.2	129.9	5585.8	1.4	30; 600

17 Jul.	FG5-202	A2	10/100	–2.933	80.7	49.2	129.9	5586.8	2.1	30; 600
17-18 Jul.	FG5-209	A2	20/100	–2.933	116.3	12.7	129.0	5589.9	2.0	30; 600
18-19 Jul.	FG5-209	A2	24/100	–2.933	116.3	12.7	129.0	5590.7	1.8	30; 600
19-20 Jul.	FG5-209	A2	15/100	–2.933	116.3	12.7	129.0	5589.9	0.9	30; 600
13-14 Jul.	FG5-211	A2	48/100	–2.933	116.4	13.1	129.5	5576.9	1.0	30; 600
14-15 Jul.	FG5-211	A2	41/100	–2.933	116.4	13.1	129.5	5576.5	0.7	30; 600
9-10 Jul.	JILA-2	A2	200/25	–3.013	75.6	14.8	90.5	5695.7	22.8	60; 550
10 Jul.	JILA-2	A2	30/25	–3.013	75.6	14.8	90.5	5706.7	25.2	60; 550
10-11 Jul.	JILA-2	A2	127/25	–3.013	75.6	14.8	90.5	5727.0	27.3	60; 550
24-25 Jul.	JILAg-5/1	A2	74/25	–3.013	–6.5	90.9	84.4	5727.7	5.5	1; 150
6-7 Jul.	JILAg-6	A2	22/175	–3.013	–5.5	97.6	92.1	5711.8	2.8	30; 600
5-6 Jul.	A10-003	B	135/25	–2.957	74.9	7.2	82.1	8022.2	21.4	120; 630
6 Jul.	A10-003	B	30/25	–2.957	74.9	7.0	81.9	8005.2	22.2	120; 630
29-30 Jul.	FG5-101	B	20/150	–2.957	116.4	12.9	129.3	7909.0	2.0	30; 600
22-23 Jul.	FG5-103	B	19/200	–2.957	80.9	49.9	130.8	7895.6	1.3	30; 600
30 Jun.	FG5-108	B	24/100	–2.957	80.6	49.3	129.9	7905.4	1.0	1; 150
6 Aug.	FG5-108	B	24/100	–2.957	80.6	49.3	129.9	7905.0	0.7	1; 150
7 Aug.	FG5-108	B	24/100	–2.957	80.6	49.3	129.9	7906.2	1.1	1; 150
8 Aug.	FG5-108	B	48/100	–2.957	80.6	49.3	129.9	7906.4	0.9	1; 150
17-18 Jul.	FG5-202	B	13/100	–2.957	80.7	49.1	129.8	7903.8	2.4	30; 600
18-19 Jul.	FG5-202	B	27/100	–2.957	80.7	49.1	129.8	7900.9	1.8	30; 600
14-15 Jul.	FG5-204	B	24/100	–2.957	80.7	48.7	129.4	7897.9	3.0	30; 600
16-17 Jul.	FG5-209	B	24/100	–2.957	116.3	12.8	129.0	7902.1	1.3	30; 600
17 Jul.	FG5-209	B	9/100	–2.957	116.3	12.8	129.0	7902.2	1.2	30; 600
9-10 Jul.	FG5-211	B	30/100	–2.957	116.4	13.1	129.4	7895.7	0.9	30; 600
10-11 Jul.	FG5-211	B	48/100	–2.957	116.4	13.1	129.4	7895.9	1.4	30; 600
11-12 Jul.	JILA-2	B	125/25	–2.971	75.6	14.5	90.2	8025.7	9.3	60; 550
20-21 Jul.	JILAg-5	B	91/25	–2.971	–6.5	90.6	84.1	8050.0	4.9	1; 150
2-3 Jul.	JILAg-6	B	14/175	–2.971	–5.5	97.5	92.0	8024.5	2.2	30; 600
3-4 Jul.	JILAg-6	B	22/175	–2.971	–5.5	97.5	92.0	8020.1	1.8	30; 600
27-28 Sep.	IMGC	B	/140	–2.971	51.2	40.6	91.7	8000.7	1.9	
3 Jul.	A10-003	B1	20/25	–2.878	74.9	7.0	81.9	8017.1	12.8	120; 630
3-4 Jul.	A10-003	B1	120/25	–2.878	74.9	7.2	82.1	8029.1	14.7	120; 630
4-5 Jul.	A10-003	B1	288/25	–2.878	74.9	7.2	82.1	8012.7	27.2	120; 630
25-27 Jul.	FG5-101	B1	25/150	–2.835	116.4	13.0	129.3	7904.0	1.3	30; 600
9-11 Jul.	FG5-105	B1	72/100	–2.835	80.7	49.2	129.9	7900.1	3.2	2; 90
11-12 Jul.	FG5-204	B1	24/100	–2.835	80.7	48.8	129.4	7895.3	6.4	30; 600
12-13 Jul.	FG5-204	B1	14/100	–2.835	80.7	48.8	129.4	7896.7	4.7	30; 600
11 Aug.	FG5-108	B1	43/100	–2.835	80.6	49.2	129.8	7904.8	1.0	1; 150
12 Aug.	FG5-108	B1	29/100	–2.835	80.6	49.2	129.8	7904.8	0.9	1; 150
20-21 Jul.	FG5-209	B1	36/100	–2.835	116.3	13.3	129.6	7899.6	1.3	30; 600
3-4 Aug.	FG5-213	B1	20/150	–2.835	116.3	11.5	127.7	7902.8	0.5	30; 600
26-27 Jul.	FG5-301	B1	20/150	–2.835	86.1	12.8	98.9	7981.9	1.8	30; 500
14-15 Jul.	JILA-2	B1	72/25	–2.878	75.6	14.5	90.1	8006.9	5.3	60; 550
19-20 Jul.	JILAg-5	B1	93/25	–2.878	–6.5	90.8	84.3	8044.7	7.3	1; 150
29-30 Sep.	IMGC	B1	/139	–2.878	51.2	41.2	92.2	7995.7	1.9	
1 Jul.	FG5-108	B3	24/100	–2.882	80.6	49.3	129.9	7891.3	1.0	1; 150
3 Jul.	FG5-108	B3	24/100	–2.882	80.6	49.3	129.9	7890.7	1.2	1; 150
4 Jul.	FG5-108	B3	36/100	–2.882	80.6	49.3	129.9	7890.6	1.4	1; 150
5 Jul.	FG5-108	B3	22/100	–2.882	80.6	49.3	129.9	7890.6	1.0	1; 150
6 Jul.	FG5-108	B3	24/100	–2.882	80.6	49.3	129.9	7891.5	1.1	1; 150
7 Jul.	FG5-108	B3	21/100	–2.882	80.6	49.3	129.9	7890.8	1.2	1; 150
8 Jul.	FG5-108	B3	24/100	–2.882	80.6	49.3	129.9	7891.0	1.1	1; 150
9 Jul.	FG5-108	B3	23/100	–2.882	80.6	49.3	129.9	7890.7	0.9	1; 150
10 Jul.	FG5-108	B3	24/100	–2.882	80.6	49.3	129.9	7890.5	1.0	1; 150
11 Jul.	FG5-108	B3	24/100	–2.882	80.6	49.3	129.9	7889.7	1.2	1; 150
12 Jul.	FG5-108	B3	24/100	–2.882	80.6	49.3	129.9	7889.8	1.0	1; 150
13 Jul.	FG5-108	B3	24/100	–2.882	80.6	49.3	129.9	7889.7	1.1	1; 150
14 Jul.	FG5-108	B3	23/100	–2.882	80.6	49.3	129.9	7889.7	1.0	1; 150

15 Jul.	FG5-108	B3	24/100	–2.882	80.6	49.3	129.9	7890.2	0.8	1; 150
16 Jul.	FG5-108	B3	24/100	–2.882	80.6	49.3	129.9	7889.7	0.9	1; 150
17 Jul.	FG5-108	B3	24/100	–2.882	80.6	49.3	129.9	7890.2	0.9	1; 150
18 Jul.	FG5-108	B3	24/100	–2.882	80.6	49.3	129.9	7889.9	1.4	1; 150
19 Jul.	FG5-108	B3	24/100	–2.882	80.6	49.3	129.9	7890.6	1.2	1; 150
20 Jul.	FG5-108	B3	3/100	–2.882	80.6	49.3	129.9	7891.2	1.1	1; 150
21 Jul.	FG5-108	B3	24/100	–2.882	80.6	49.3	129.9	7890.0	1.2	1; 150
22 Jul.	FG5-108	B3	14/100	–2.882	80.6	49.3	129.9	7890.9	1.2	1; 150
22 Jul.	FG5-108	B3	24/100	–2.882	80.6	49.3	129.9	7891.0	1.1	1; 150
23 Jul.	FG5-108	B3	24/100	–2.882	80.6	49.3	129.9	7890.9	1.0	1; 150
24 Jul.	FG5-108	B3	24/100	–2.882	80.6	49.3	129.9	7890.9	0.9	1; 150
26 Jul.	FG5-108	B3	24/100	–2.882	80.6	49.3	129.9	7890.5	1.1	1; 150
27 Jul.	FG5-108	B3	24/100	–2.882	80.6	49.3	129.9	7890.5	1.4	1; 150
28 Jul.	FG5-108	B3	24/100	–2.882	80.6	49.3	129.9	7891.0	0.9	1; 150
29 Jul.	FG5-108	B3	24/100	–2.882	80.6	49.3	129.9	7890.2	0.9	1; 150
30 Jul.	FG5-108	B3	22/100	–2.882	80.6	49.3	129.9	7891.0	0.9	1; 150
31 Jul.	FG5-108	B3	21/100	–2.882	80.6	49.3	129.9	7890.2	1.1	1; 150
1 Aug.	FG5-108	B3	24/100	–2.882	80.6	49.3	129.9	7889.4	0.9	1; 150
3 Aug.	FG5-108	B3	24/100	–2.882	80.6	49.3	129.9	7891.0	0.6	1; 150
1-2 Oct.	IMGC	B3	/138	–2.943	51.2	40.8	92.3	7974.5	1.9	

Explanations of columns in Table 4

1. Date of measurements.
2. Gravimeter.
3. Site.
4. Number of sets and number of drops per set.
5. Least-squares gradient used in the equation of motion for the gravimeters.
6. Instrument height as given by the manufacturer.
7. Reference height as measured by the operator.
8. Height of the observations ($Z_{\mathrm{inst}} + Z_{\mathrm{ref}}$) corresponding to the top of the path of the test body. For JILAg-5/1 and JILAg-5 Z_{top} is the height where the calculated *g*-value is referred, which is 7.1 cm below the start of the drop.
9. *g*-value at Z_{top}, expressed as in microgals.
10. Set standard deviation of *g*-value.
11. Scaled fringes: starting fringe; number of fringes to fit.

For each gravimeter the mean *g*-values at height Z_{top} (column 9 in Table 4) were then transferred to a height of 0.9 m over the sites using the polynomials for the gravity field distributions (see formula (3) and Table 3). These transferred g-values were used for the combined adjustment of the absolute and relative data. The results of the combined adjustment are presented in various forms in Tables 5, 5a, 5b and Tables 6, 6a, 6b.

Tables 5, 5a, 5b represent the results of the combined adjustment of all the relative and absolute data including the weighted and unweighted means at the sites A and B. Tables 6, 6a and 6b omit the data from some of the absolute gravimeters. The results of the measurements of A10-003 at the sites A and A2 were rejected because, as it can be seen in Tables 5 and 5a, the residuals (differences between the adjusted and measured *g*-values at height 0.90 m) at these sites are bigger than three times 11.5 μGal (the standard deviation of the differences between the g-values transferred to the site A at 0.90 m and their unweighted mean). The data of FG5-301 were omitted because these results were processed with an unexplained shift of 17 μGal recommended by manufacturer. The data from the JILAg-5 and IMGC gravimeters were omitted in Tables 6, 6a and 6b because the raw data of their measurements were not presented.

The following symbols are used in Tables 5, 5a, 5b, 6, 6a and 6b:

1. No.: number of the measurement, defined as the number of the gravimeter and point number.
2. Grav.: type and serial number of the absolute gravimeter.
3. P: point for which the *g*-value is given, defined as the site and the height of the point in centimetres.

4. g: g-value transferred from height Z_{top} (see Table 4, column 9) to the point 0.90 m above the plug of the ground disk at the site. This transfer is calculated using the corresponding polynomials representing g as a function of height.
5. $\overline{g}$: g-value obtained by combined adjustment.
6. $\overline{g} - g$: residuals of adjusted g-values.
7. $\bar{u}$: least-square error of $\overline{g}$.
8. w: weight of g-value in the combined adjustment calculated as described in 4.2.2.
9. $\tilde{g}_{\mathrm{A}}$: g-value transferred to point A at a height of 0.90 m using the g-difference obtained by the combined adjustment.
10. $\tilde{g}_{\mathrm{B}}$: g-value transferred to point B at a height 0.90 m using the g-difference obtained by the combined adjustment.
11. $\tilde{g}_{\mathrm{A}} - \hat{\tilde{g}}_{\mathrm{A}}$: difference between $\tilde{g}_{\mathrm{A}}$ and the unweighted mean value $\hat{\tilde{g}}_{\mathrm{A}}$, averaged over all the $\tilde{g}_{\mathrm{A}}$.
12. $\tilde{g}_{\mathrm{A}} - \hat{\tilde{g}}_{\mathrm{A},w}$: difference between $\tilde{g}_{\mathrm{A}}$ and the weighted mean value $\hat{\tilde{g}}_{\mathrm{A},w}$, averaged over all the $\tilde{g}_{\mathrm{A}}$.
13. $\tilde{g}_{\mathrm{A}} - \hat{\tilde{g}}^{\mathrm{P}}_{\mathrm{A},w}$: differences between $\tilde{g}_{\mathrm{A}}$ and the weighted mean $\hat{\tilde{g}}^{\mathrm{P}}_{\mathrm{A},w}$, averaged with the weights w over the data transferred from the given point P (P = A2, B, B1) to A or measured at A ($\hat{\tilde{g}}^{\mathrm{A}}_{\mathrm{A},w}$).
14. $\hat{\tilde{\mathrm{g}}}_{\mathrm{grav,A}} \pm \sigma_{\hat{\mathrm{g}}};\hat{\varepsilon}$: unweighted mean values of $\tilde{g}_{\mathrm{A}}$ for each absolute gravimeter, and its standard deviation $\sigma_{\hat{g}}$; the difference $\hat{\varepsilon}$ between $\hat{\tilde{\mathrm{g}}}_{\mathrm{grav,A}}$ and the weighted mean value $\hat{\tilde{g}}_{A,w} = 5700.5$ μGal of all the $\tilde{g}_{\mathrm{A}}$ in Table 5, and the weighted mean value $\hat{\tilde{g}}_{A,w} = 5701.2$ μGal of all the $\tilde{g}_{\mathrm{A}}$ in Table 6.

Table 5. Results (expressed in microgals after subtraction of the reference value of 980 920 000 µGal) of the combined adjustment of absolute and relative measurement data during ICAG-2001 for all the absolute gravimeters.

No.	Grav.	P	g	$\bar{g}$	$\bar{g}-g$	$\bar{u}$	w	$\tilde{g}_{\mathrm{A}}$	$\tilde{g}_{\mathrm{B}}$	$\tilde{g}_A-\hat{\tilde{g}}_A$	$\tilde{g}_{\mathrm{A}}-\hat{\tilde{g}}_{\mathrm{A},w}$	$\tilde{g}_{\mathrm{A}}-\hat{\tilde{g}}^{\mathrm{P}}_{\mathrm{A},w}$	$\hat{\tilde{g}}_{grav,A}\pm\sigma_{\hat{g}}$; $\hat{\varepsilon}$
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1_1	A10_003	A.090	5665.6	5700.5	34.9	0.8	0.02	5665.6	7983.4	–32.9	–34.9	–36.1	5669.7±12.3;
1_2	A10_003	A2.090	5659.8	5706.2	46.3	0.9	0.04	5654.2	7972.0	–44.3	–46.3	–46.1	–30.8
1_3	A10_003	B.090	7995.7	8018.3	22.7	0.8	0.08	5677.9	7995.7	–20.6	–22.6	–23.3	
1_4	A10_003	B1.090	7994.4	8013.8	19.4	0.9	0.09	5681.1	7998.9	–17.4	–19.4	–17.0	
2_1	FG5_101	A.090	5699.8	5700.5	0.8	0.8	1.16	5699.8	8017.5	1.3	–0.7	–1.9	5703.4±4.0;
2_3	FG5_101	B.090	8025.5	8018.3	–7.2	0.8	0.97	5707.7	8025.5	9.2	7.2	6.5	2.9
2_4	FG5_101	B1.090	8016.0	8013.8	–2.2	0.9	1.08	5702.7	8020.5	4.2	2.2	4.6	
3_1	FG5_103	A.090	5703.7	5700.5	–3.2	0.8	1.15	5703.7	8021.5	5.2	3.2	2.0	5701.7±2.7;
3_2	FG5_103	A2.090	5708.6	5706.2	–2.4	0.9	1.13	5702.9	8020.7	4.4	2.4	2.6	1.2
3_3	FG5_103	B.090	8016.4	8018.3	1.9	0.8	1.07	5698.6	8016.4	0.1	–1.9	–2.6	
4_1	FG5_105	A.090	5698.7	5700.5	1.8	0.8	1.11	5698.7	8016.5	0.2	–1.8	–3.0	5698.5±2.0;
4_2	FG5_105	A2.090	5702.1	5706.2	4.1	0.9	0.69	5696.4	8014.2	–2.1	–4.1	–3.9	–2.0
4_4	FG5_105	B1.090	8013.7	8013.8	0.1	0.9	0.75	5700.4	8018.2	1.9	–0.1	2.3	
5_1	FG5_108	A.090	5705.9	5700.5	–5.4	0.8	1.16	5705.9	8023.7	7.4	5.4	4.2	5705.9±0.7;
5_2	FG5_108	A2.090	5712.2	5706.2	–6.0	0.9	1.16	5706.5	8024.3	8.0	6.0	6.2	5.4
5_3	FG5_108	B.090	8024.2	8018.3	–5.9	0.8	1.17	5706.4	8024.2	7.9	5.9	5.2	
5_4	FG5_108	B1.090	8018.2	8013.8	–4.4	0.9	1.15	5704.9	8022.7	6.4	4.4	6.8	
6_1	FG5_202	A.090	5701.9	5700.5	–1.4	0.8	1.11	5701.9	8019.7	3.4	1.4	0.2	5700.8±2.1;
6_2	FG5_202	A2.090	5704.0	5706.2	2.2	0.9	1.12	5698.3	8016.1	–0.2	–2.2	–2.0	0.3
6_3	FG5_202	B.090	8019.9	8018.3	–1.6	0.8	1.02	5702.1	8019.9	3.6	1.6	0.9	
7_1	FG5_204	A.090	5696.0	5700.5	4.5	0.8	0.8	5696.0	8013.8	–2.5	–4.5	–5.7	5695.9±1.0;
7_3	FG5_204	B.090	8014.6	8018.3	3.7	0.8	0.79	5696.8	8014.6	–1.7	–3.7	–4.4	–4.6
7_4	FG5_204	B1.090	8008.1	8013.8	5.7	0.9	0.61	5694.8	8012.6	–3.7	–5.7	–3.3	
8_1	FG5_206	A.090	5706.1	5700.5	–5.6	0.8	1.13	5706.1	8023.9	7.6	5.6	4.4	5706.1; 5.6
9_2	FG5_209	A2.090	5705.0	5706.2	1.2	0.9	1.12	5699.3	8017.1	0.8	–1.2	–1.0	5699.4±0.6;
9_3	FG5_209	B.090	8017.8	8018.3	0.5	0.8	1.13	5700.0	8017.8	1.5	–0.5	–1.2	–1.1
9_4	FG5_209	B1.090	8012.2	8013.8	1.6	0.9	1.08	5698.9	8016.7	0.4	–1.6	0.8	
10_1	FG5_211	A.090	5694.6	5700.5	5.9	0.8	1.12	5694.6	8012.4	–3.9	–5.9	–7.1	5692.4±4.0;
10_2	FG5_211	A2.090	5693.5	5706.2	12.7	0.9	1.15	5687.8	8005.6	–10.7	–12.7	–12.5	–8.1
10_3	FG5_211	B.090	8012.6	8018.3	5.7	0.8	1.13	5694.8	8012.6	–3.7	–5.7	–6.4	
11_1	FG5_213	A.090	5701.0	5700.5	–0.5	0.8	1.09	5701.0	8018.8	2.5	0.5	-0.7	5699.0±2.9;
11_4	FG5_213	B1.090	8010.2	8013.8	3.6	0.9	1.17	5696.9	8014.7	–1.6	–3.6	–1.2	–1.5
12_1	FG5_301	A.090	5698.0	5700.5	2.5	0.8	1.03	5698.0	8015.8	–0.5	–2.5	–3.7	5696.1±2.8;
12_4	FG5_301	B1.090	8007.4	8013.8	6.4	0.9	1.00	5694.1	8011.9	–4.4	–6.4	–4.0	–4.5
13_2	JILA_2	A2.090	5709.2	5706.2	–3.0	0.9	0.07	5703.5	8021.3	5.0	3.0	3.2	5702.0±7.3;
13_3	JILA_2	B.090	8026.2	8018.3	–7.9	0.8	0.2	5708.4	8026.2	9.9	7.9	7.2	1.5
13_4	JILA_2	B1.090	8007.3	8013.8	6.5	0.9	0.46	5694.0	8011.8	–4.5	–6.5	–4.1	
14_1	JILAg_5/1	A.090	5707.3	5700.5	–6.8	0.8	0.38	5707.3	8025.1	8.8	6.8	5.6	5706.2±1.6;
14_2	JILAg_5/1	A2.090	5710.8	5706.2	–4.6	0.9	0.44	5705.1	8022.9	6.6	4.6	4.8	5.7
15_3	JILAg_5	B.090	8032.5	8018.3	–14.2	0.8	0.51	5714.7	8032.5	16.2	14.2	13.5	5714.9±0.2;
15_4	JILAg_5	B1.090	8028.3	8013.8	–14.5	0.9	0.30	5715.0	8032.8	16.5	14.5	16.9	14.4
16_1	JILAg_6	A.090	5711.0	5700.5	–10.5	0.8	0.95	5711.0	8028.8	12.5	10.5	9.3	5711.2±1.3;
16_2	JILAg_6	A2.090	5718.2	5706.2	–12.0	0.9	0.82	5712.5	8030.3	14.0	12.0	12.2	10.7
16_3	JILAg_6	B.090	8027.8	8018.3	–9.5	0.8	0.95	5710.0	8027.8	11.5	9.5	8.8	
17_3	IMGC	B.090	8005.7	8018.3	12.6	0.8	0.98	5687.9	8005.7	–10.6	–12.6	–13.3	5688.4±0.7;
17_4	IMGC	B1.090	8002.2	8013.8	11.6	0.9	0.98	5688.9	8006.7	–9.6	–11.6	–9.2	–12.1

Table 5a. Results of the measurements (expressed in microgals after the subtraction of the reference value of 980 920 000 µGal) transferred to the sites A and B at 0.9 m.

Transfer to A				Transfer to B			
Unweighted mean		Weighted mean		Unweighted mean		Weighted mean	
$\hat{\tilde{g}}_{\mathrm{A}}$	5698.5±11.5	$\hat{\tilde{g}}_{\mathrm{A},w}$	5700.5±6.6	$\hat{\tilde{g}}_{\mathrm{B}}$	8016.3±11.5	$\hat{\tilde{g}}_{\mathrm{B},w}$	8018.3±6.6
$\hat{\tilde{g}}_{\mathrm{A}}^{\mathrm{A}}$	5699.2±10.8	$\hat{\tilde{g}}_{\mathrm{A},w}^{\mathrm{A}}$	5701.7±4.9	$\hat{\tilde{g}}_{\mathrm{B}}^{\mathrm{A}}$	8017.0±10.8	$\hat{\tilde{g}}_{\mathrm{B},w}^{\mathrm{A}}$	8019.5±4.9
$\hat{\tilde{g}}_{\mathrm{A}}^{\mathrm{A2}}$	5696.6±16.0	$\hat{\tilde{g}}_{\mathrm{A},w}^{\mathrm{A2}}$	5700.3±7.8	$\hat{\tilde{g}}_{\mathrm{B}}^{\mathrm{A2}}$	8014.4±16.0	$\hat{\tilde{g}}_{\mathrm{B},w}^{\mathrm{A2}}$	8018.1±7.8
$\hat{\tilde{g}}_{\mathrm{A}}^{\mathrm{B}}$	5700.4±9.8	$\hat{\tilde{g}}_{\mathrm{A},w}^{\mathrm{B}}$	5701.2±7.4	$\hat{\tilde{g}}_{\mathrm{B}}^{\mathrm{B}}$	8018.2±9.8	$\hat{\tilde{g}}_{\mathrm{B},w}^{\mathrm{B}}$	8019.0±7.4
$\hat{\tilde{g}}_{\mathrm{A}}^{\mathrm{B1}}$	5697.4±8.9	$\hat{\tilde{g}}_{\mathrm{A},w}^{\mathrm{B1}}$	5698.1±6.4	$\hat{\tilde{g}}_{\mathrm{B}}^{\mathrm{B1}}$	8015.2±8.9	$\hat{\tilde{g}}_{\mathrm{B},w}^{\mathrm{B1}}$	8015.9±6.4

Table 5b. Unweighted and weighted means of the results of the measurement at each site at 0.9 m (expressed in microgals after the subtraction of the reference value of 980 920 000 µGal).

Unweighted mean		Weighted mean	
$\hat{\tilde{g}}_{\mathrm{A}}^{\mathrm{A}}$	5699.2±10.8	$\hat{\tilde{g}}_{\mathrm{A},w}^{\mathrm{A}}$	5701.7±4.9
$\hat{\tilde{g}}_{\mathrm{A2}}^{\mathrm{A2}}$	5702.3±16.0	$\hat{\tilde{g}}_{\mathrm{A2},w}^{\mathrm{A2}}$	5706.2±7.8
$\hat{\tilde{g}}_{\mathrm{B}}^{\mathrm{B}}$	8018.2±9.8	$\hat{\tilde{g}}_{\mathrm{B},w}^{\mathrm{B}}$	8019.0±7.4
$\hat{\tilde{g}}_{\mathrm{B1}}^{\mathrm{B1}}$	8010.7±8.9	$\hat{\tilde{g}}_{\mathrm{B1},w}^{\mathrm{B1}}$	8011.4±6.4

Table 6. Results (expressed in microgals after the subtraction of the reference value of 980 920 000 µGal) of the combined adjustment of absolute and relative measurement data during ICAG-2001, omitting the data from the gravimeters IMGC, FG5-301 and JILAg-5 and the data of A10-003 at A, A2).

No.	Grav.	P	g	$\bar{g}$	$\bar{g}-g$	$\bar{u}$	w	$\tilde{g}_A$	$\tilde{g}_B$	$\tilde{g}_A-\hat{\tilde{g}}_A$	$\tilde{g}_A-\hat{\tilde{g}}_{A,w}$	$\tilde{g}_A-\hat{\tilde{g}}^P_{A,w}$	$\hat{\tilde{g}}_{grav,A}\pm\sigma_{\hat{g}}$; $\hat{\varepsilon}$
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1_3	A10_003	B.090	7995.7	8018.8	23.1	0.9	0.08	5678.1	7995.7	−22.1	−23.1	−24.0	5679.6±2.1;
1_4	A10_003	B1.090	7994.4	8014.5	20.1	0.9	0.09	5681.1	7998.7	−19.1	−20.1	−18.3	−21.6
2_1	FG5_101	A.090	5699.8	5701.2	1.5	0.9	1.16	5699.8	8017.4	−0.4	−1.4	−2.1	5703.5±4.1;
2_3	FG5_101	B.090	8025.5	8018.8	−6.7	0.9	0.97	5707.9	8025.5	7.7	6.7	5.8	2.3
2_4	FG5_101	B1.090	8016.0	8014.5	−1.5	0.9	1.08	5702.7	8020.3	2.5	1.5	3.3	
3_1	FG5_103	A.090	5703.7	5701.2	−2.5	0.9	1.15	5703.7	8021.3	3.5	2.5	1.8	5701.9±2.7;
3_3	FG5_103	A2.090	5708.6	5706.6	−2.0	0.9	1.13	5703.2	8020.8	3.0	2.0	2.6	0.7
3_4	FG5_103	B.090	8016.4	8018.8	2.4	0.9	1.07	5698.8	8016.4	−1.4	−2.4	−3.3	
4_1	FG5_105	A.090	5698.7	5701.2	2.5	0.9	1.11	5698.7	8016.3	−1.5	−2.5	−3.2	5698.6±1.9;
4_2	FG5_105	A2.090	5702.1	5706.6	4.5	0.9	0.69	5696.7	8014.3	−3.5	−4.5	−3.9	−2.6
4_3	FG5_105	B1.090	8013.7	8014.5	0.8	0.9	0.75	5700.4	8018.0	0.2	−0.8	1.0	
5_1	FG5_108	A.090	5705.9	5701.2	−4.7	0.9	1.16	5705.9	8023.5	5.7	4.7	4.0	5706.1±0.9;
5_2	FG5_108	A2.090	5712.2	5706.6	−5.6	0.9	1.16	5706.8	8024.4	6.6	5.6	6.2	4.8
5_3	FG5_108	B.090	8024.2	8018.8	−5.4	0.9	1.17	5706.6	8024.2	6.4	5.4	4.5	
5_4	FG5_108	B1.090	8018.2	8014.5	−3.7	0.9	1.15	5704.9	8022.5	4.7	3.7	5.5	
6_1	FG5_202	A.090	5701.9	5701.2	−0.7	0.9	1.11	5701.9	8019.5	1.7	0.7	0.0	5700.9±2.0;
6_2	FG5_202	A2.090	5704.0	5706.6	2.6	0.9	1.12	5698.6	8016.2	−1.6	−2.6	−2.0	−0.3
6_3	FG5_202	B.090	8019.9	8018.8	−1.1	0.9	1.02	5702.3	8019.9	2.1	1.1	0.2	
7_1	FG5_204	A.090	5696.0	5701.2	5.2	0.9	0.80	5696.0	8013.6	−4.2	−5.2	−5.9	5695.9±1.1;
7_3	FG5_204	B.090	8014.6	8018.8	4.2	0.9	0.79	5697.0	8014.6	−3.2	−4.2	−5.1	−5.3
7_4	FG5_204	B1.090	8008.1	8014.5	6.4	0.9	0.61	5694.8	8012.4	−5.4	−6.4	−4.6	
8_1	FG5_206	A.090	5706.1	5701.2	−4.9	0.9	1.13	5706.1	8023.7	5.9	4.9	4.2	5706.1; 4.9
9_2	FG5_209	A2.090	5705.0	5706.6	1.6	0.9	1.12	5699.6	8017.2	−0.6	−1.6	−1.0	5699.6±0.7;
9_3	FG5_209	B.090	8017.8	8018.8	1.0	0.9	1.13	5700.2	8017.8	0.0	−1.0	−1.9	−1.6
9_4	FG5_209	B1.090	8012.2	8014.5	2.3	0.9	1.08	5698.9	8016.5	−1.3	−2.3	−0.5	
10_1	FG5_211	A.090	5694.6	5701.2	6.6	0.9	1.12	5694.6	8012.2	−5.6	−6.6	−7.3	5692.6±3.9;
10_2	FG5_211	A2.090	5693.5	5706.6	13.1	0.9	1.15	5688.1	8005.7	−12.1	−13.1	−12.5	−8.6
10_3	FG5_211	B.090	8012.6	8018.8	6.2	0.9	1.13	5695.0	8012.6	−5.2	−6.2	−7.1	
11_1	FG5_213	A.090	5701.0	5701.2	0.2	0.9	1.09	5701.0	8018.6	0.8	−0.2	−0.9	5699.0±2.9;
11_3	FG5_213	B1.090	8010.2	8014.5	4.3	0.9	1.17	5696.9	8014.5	−3.3	−4.3	−2.5	−2.2
13_2	JILA_2	A2.090	5709.2	5706.6	−2.6	0.9	0.07	5703.8	8021.4	3.6	2.6	3.2	5702.1±7.4;
13_3	JILA_2	B.090	8026.2	8018.8	−7.4	0.9	0.20	5708.6	8026.2	8.4	7.4	6.5	0.9
13_4	JILA_2	B1.090	8007.3	8014.5	7.2	0.9	0.46	5694.0	8011.6	−6.2	−7.2	−5.4	
16_1	JILAg_6	A.090	5711.0	5701.2	−9.8	0.9	0.95	5711.0	8028.6	10.8	9.8	9.1	5711.3±1.3;
16_2	JILAg_6	A2.090	5718.2	5706.6	−11.5	0.9	0.82	5712.8	8030.3	12.6	11.6	12.2	10.1
16_3	JILAg_6	B.090	8027.8	8018.8	−9.0	0.9	0.95	5710.2	8027.8	10.0	9.0	8.1	

Table 6a. Results of the measurements (expressed in microgals after the subtraction of the reference value of 980 920 000 µGal) transferred to the sites A and B at 0.9 m.

Transfer to A				Transfer to B			
Unweighted mean		Weighted mean		Unweighted mean		Weighted mean	
$\hat{\tilde{g}}_{\mathrm{A}}$	5700.2±7.4	$\hat{\tilde{g}}_{\mathrm{A},w}$	5701.2±5.5	$\hat{\tilde{g}}_{\mathrm{B}}$	8017.8±7.4	$\hat{\tilde{g}}_{\mathrm{B},w}$	8018.8±5.5
$\hat{\tilde{g}}_{\mathrm{A}}^{\mathrm{A}}$	5701.9±4.8	$\hat{\tilde{g}}_{\mathrm{A},w}^{\mathrm{A}}$	5701.9±4.6	$\hat{\tilde{g}}_{\mathrm{B}}^{\mathrm{A}}$	8019.5±4.8	$\hat{\tilde{g}}_{\mathrm{B},w}^{\mathrm{A}}$	8019.5±4.6
$\hat{\tilde{g}}_{\mathrm{A}}^{\mathrm{A2}}$	5701.2±6.9	$\hat{\tilde{g}}_{\mathrm{A},w}^{\mathrm{A2}}$	5700.6±7.2	$\hat{\tilde{g}}_{\mathrm{B}}^{\mathrm{A2}}$	8018.8±6.9	$\hat{\tilde{g}}_{\mathrm{B},w}^{\mathrm{A2}}$	8018.2±7.2
$\hat{\tilde{g}}_{\mathrm{A}}^{\mathrm{B}}$	5700.5±9.0	$\hat{\tilde{g}}_{\mathrm{A},w}^{\mathrm{B}}$	5702.1±5.7	$\hat{\tilde{g}}_{\mathrm{B}}^{\mathrm{B}}$	8018.0±9.0	$\hat{\tilde{g}}_{\mathrm{B},w}^{\mathrm{B}}$	8019.7±5.7
$\hat{\tilde{g}}_{\mathrm{A}}^{\mathrm{B1}}$	5696.7±8.2	$\hat{\tilde{g}}_{\mathrm{A},w}^{\mathrm{B1}}$	5699.4±4.5	$\hat{\tilde{g}}_{\mathrm{B}}^{\mathrm{B1}}$	8014.3±8.2	$\hat{\tilde{g}}_{\mathrm{B},w}^{\mathrm{B1}}$	8017.0±4.5

Table 6b. Unweighted and weighted means of the results of the measurement at each site at 0.9 m (expressed in microgals after the subtraction of the reference value of 980 920 000 µGal).

Unweighted mean		Weighted mean	
$\hat{\tilde{g}}_{\mathrm{A}}^{\mathrm{A}}$	5701.9±4.8	$\hat{\tilde{g}}_{\mathrm{A},w}^{\mathrm{A}}$	5701.9±4.6
$\hat{\tilde{g}}_{\mathrm{A2}}^{\mathrm{A2}}$	5706.6±6.9	$\hat{\tilde{g}}_{\mathrm{A2},w}^{\mathrm{A2}}$	5706.0±7.2
$\hat{\tilde{g}}_{\mathrm{B}}^{\mathrm{B}}$	8018.1±9.0	$\hat{\tilde{g}}_{\mathrm{B},w}^{\mathrm{B}}$	8019.7±5.7
$\hat{\tilde{g}}_{\mathrm{B1}}^{\mathrm{B1}}$	8010.0±8.2	$\hat{\tilde{g}}_{\mathrm{B1},w}^{\mathrm{B1}}$	8012.7±4.5

Table 7 represents the results of the different versions of the adjustment of the relative and absolute data. In this table “adj*i*” designates

- “adj1”: the combined adjustment of the weighted absolute and relative data with some omitted data as in the calculation of Table 6;
- “adj2”: the combined adjustment of all the weighted absolute and relative data as in the calculation of Table 5;
- “adj3”: the adjustment of only unweighted absolute data of all the absolute gravimeters;

- “adj4”: the adjustment of only weighted absolute data of all the absolute gravimeters;
- “adj5”: the adjustment of only weighted absolute data with some omitted gravimeters (as in the calculation of the Table 6);
- “adj6”: the adjustment of only relative data (see Table 2) where the Hanover vertical calibration scale was used [14].

$\varDelta_{1,i}^{\mathrm{P}}$ is the difference of the result at the point P of the adjustment “adj1” and corresponding result of the adjustment “adj*i*”, where $i = 2, 3, 4, 5, 6$.

Table 7. Comparison of the results of the different versions of the adjustment of the relative and absolute data of the ICAG-2001. Weighted mean of all the g-values (g-g_r) transferred to the points A, A2, B or B1 at the height 0.9 m are expressed in microgals after the subtraction of the reference value of 980 920 000 µGal. Differences $\Delta^{P}_{1,i}$ are expressed in microgals. M is the mean square error.

Adjustment		A.090		A2.090		B.090		B1.090	
		(g-g_r)	M	(g-g_r)	M	(g-g_r)	M	(g-g_r)	M
1	Combined “adj1”(Table 6)	5701.2	0.9	5706.6	0.9	8018.8	0.9	8014.5	0.9
2	Combined “adj2”(Table 5)	5700.5	0.8	5706.2	0.9	8018.3	0.8	8013.8	0.9
3	“adj3”(only absolute data)	5698.5	2.2	5701.8	2.4	8018.2	2.2	8012.0	2.4
4	“adj4”(only absolute data)	5700.9	1.2	5705.8	1.2	8019.1	1.2	8012.7	1.2
5	“adj5”(only absolute data)	5701.4	1.2	5706.3	1.3	8019.6	1.3	8013.4	1.3
6	“adj6” (only relative data; Table 2)	5701.2	0.0	5706.3	0.4	8019.3	0.7	8015.6	0.7
		$\Delta^{A}_{1,i}$		$\Delta^{A2}_{1,i}$		$\Delta^{B}_{1,i}$		$\Delta^{B1}_{1,i}$	
7	Difference between “adj1” and “adj2”	0.7		0.4		0.5		0.7	
8	Difference between “adj1” and “adj3”	2.7		4.8		0.6		2.5	
9	Difference between “adj1” and “adj4”	0.3		0.8		–0.3		1.8	
10	Difference between “adj1” and “adj5”	–0.2		0.3		–0.8		1.1	
11	Difference between “adj1” and “adj6”	0.0		0.3		–0.5		–1.1	

The results of the adjustment “adj6” of the data of relative measurements with the fixed calibration scale of the gravimeters of Hanover University (see Table 2) and that of the combined adjustment “adj1” of the absolute and relative data are presented in Table 8.

Table 8. Comparison of the results of the adjustment of the data of relative measurements (“adj6”) at each point and corresponding results of the combined adjustment of the absolute and relative data (“adj1”, see Tables 6 and 7). The results are expressed in microgals after the subtraction of the reference value of 980 920 000 μGal. $\Delta_{1,6}$ is the difference between the results of “adj1” and “adj6”.

No.	Point	“adj6”	*m*	“adj1”	*M*	$\Delta_{1,6}$
1	A.005	5968.2	0.7	5968.0	1.1	–0.2
2	A.030	5887.6	0.4	5887.4	1.0	–0.2
3	A.090	5701.2	0.0	5701.2	0.9	–0.0
4	A.130	5580.4	0.4	5580.4	1.0	–0.0
5	A2.005	5972.0	0.8	5971.8	1.1	–0.2
6	A2.030	5890.5	0.5	5890.7	1.0	0.2
7	A2.090	5706.3	0.4	5706.6	0.9	0.3
8	A2.130	5586.8	0.5	5587.2	1.0	0.4
9	B.005	8273.4	1.0	8272.8	1.1	–0.6
10	B.030	8197.6	0.8	8197.1	1.0	–0.5
11	B.090	8019.3	0.7	8018.8	0.9	–0.5
12	B.130	7900.2	0.7	7899.8	1.0	–0.4
13	B1.005	8266.2	1.0	8265.1	1.1	–1.1
14	B1.030	8191.0	0.9	8189.9	1.0	–1.1
15	B1.090	8015.6	0.7	8014.5	0.9	–1.1
16	B1.130	7901.4	0.8	7900.4	1.0	–1.0
17	B3.005	8259.7	1.2	8259.0	1.3	–0.7
18	B3.030	8183.3	0.9	8182.5	1.1	–0.8
19	B3.090	8002.3	0.8	8001.7	1.0	–0.6
20	B3.130	7886.4	0.9	7885.8	1.1	–0.6
21	L3.005	6852.8	1.0	6852.1	1.2	–0.7
22	L3.030	6783.4	0.7	6782.7	1.0	–0.7
23	L3.090	6618.7	0.5	6618.1	0.9	–0.6
24	L3.130	6510.8	0.6	6510.2	1.0	–0.6
25	L4.005	6868.2	1.1	6868.0	1.3	–0.2
26	L4.030	6798.7	0.7	6798.6	1.0	–0.1
27	L4.090	6632.8	0.5	6632.8	0.9	0.0
28	L4.130	6522.1	0.7	6522.1	1.0	0.0
Standard deviation of Δ = 0.5						

Figure 5 shows the results of the absolute measurements, transferred to the height 0.9 m at the site A, during the ICAG-97 (see Table 7 and Figure 1 in [9]) and the ICAG-2001 (see column 14 in Table 6). The unweighted mean value of all the absolute measurements transferred to the point A.090 during ICAG-97 was (980925707.8 ± 2.8) μGal which is 6.6 μGal higher than the weighted mean

$\hat{\tilde{g}}_{\mathrm{A},w}$ = (9809205701.2 ± 5.5) μGal obtained in the ICAG-2001. It should be noted that the results of the measurements in 1997 and 2001 at the point A.090 using the absolute gravimeter FG5-108 of the BIPM coincide within 1 μGal.

The mean value and its standard deviation of the almost continuous measurements from 1 July to 3 August 2001 at the point B3.090 using the gravimeter FG5-108 are (980925890.5 ± 0.6) μGal. This confirms a good stability of the gravity field at the BIPM during the ICAG-2001.

CONCLUSIONS

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