Lantmäterirapport 2019:3

Reports in Geodesy and Geographical Information Systems

RG 2000

– a comprehensive overview on the new gravity reference frame of Sweden

Andreas Engfeldt

Gävle 2019

LANTMÄTERIET

LANTMÄTERIET

2019-12-30

Author Andreas Engfeldt

Typography and layout Rainer Hertel

Total number of pages 328

Lantmäterirapport 2019:3 ISSN 0280-5731

RG 2000

– a comprehensive overview on the new gravity reference frame of Sweden

Andreas Engfeldt

Gävle 2019

LANTMÄTERIET

Preface

The author would like to thank all observers who have participated in one or the other way in this project. Especially, the author would like to send some thoughts to the late Swedish relative gravity experts Lars Åke Haller (1938-2001) and Lennart Pettersson (1918-1998). The author would also in particular like to thank Ludger Timmen and Olga Gitlein who performed many gravity measurements with the FG5-220 in Sweden during 2003-2008 and Holger Steffen for valuable comments and remarks on an earlier version of this report.

Abstract

This report is about the new Swedish national reference frame and system for gravity, RG 2000. It contains detailed information about how the frame and the system was developed, like point information, how the points were observed, how the calculations and adjustment were performed and more.

RG 2000 is based on time series of absolute gravity observations with the instrument FG5 on 18 points (Class A points) at 14 different stations. It also includes 95 points (Class B points) observed with an A10 instrument. These absolute gravity points are connected with observations from the relative gravimeter types Scintrex CG5 and LaCoste & Romberg model G to each other and/or 230 Class C points. The Class C points are connected to a number of other Class C points with relative gravimeter observations. 148 additional points, observed only with relative gravimeters, are classified as Class D and were included in a second order adjustment.

In order to harmonize the Swedish reference frames, the postglacial epoch of RG 2000 is set to 2000.0. The post glacial gravity change model NKG2016LU_gdot has been used to transform all data to this epoch. NKG2016LU_gdot is based on the land uplift model NKG2016LU_abs and has used the factor -0.163 µGal/m to convert the metres into mGal. Furthermore, transformations have been developed to the two previous gravity systems of Sweden, RG 82 and RG 62.

The first realization of RG 2000 was finished in February 2018 and a second improved realization with extended and slightly corrected data was finished in October 2019. The realization from 2019 is the valid realization today. If improved absolute or relative data become available in the future or improved land uplift models are developed, new realizations may be provided.

Sammanfattning

Den här rapporten handlar om det nya svenska nationella referenssystemet och referensnätet för tyngdkraft, RG 2000. Rapporten innehåller detaljinformation om det mesta angående hur systemet togs fram, såsom vilka punkter som ingår, hur de mätts, hur beräkningen och utjämningen gått till m.m.

RG 2000 baseras på tidsserier från 18 punkter (Klass A) på 14 olika stationer som mätts med absolutgravimetern FG5. Det innehåller även 95 punkter (Klass B) som mätts med absolutgravimetern A10. Klass A och B punkterna har bundits ihop med varandra och/eller 230 Klass C punkter med hjälp av mätningar med relativa gravimetrar av typen Scintrex CG5 och/eller typen LaCoste & Romberg modell G. Dessa Klass C punkter är i sin tur ihopbundna med ett antal andra Klass C punkter genom mätningar med relativa gravimetrar. Ytterligare 148 punkter mätta med enbart relativa gravimetrar är klassificerade (Klass D) och ingick i en andra ordningens utjämning.

För att harmonisera de svenska referenssystemen har RG 2000 fått landhöjningsepoken 2000.0 och i arbetet har konverteringsmodellen NKG2016LU_gdot använts. Den modellen är baserad på landhöjningsmodellen NKG2016LU_abs och använder faktorn -0.163 µGal/m för att konvertera meter till mGal. För referenssystemsbyte från något av de två tidigare svenska tyngdkraftssystemen, RG 82 och RG 62, har transformationer utvecklats.

Den första realiseringen av RG 2000 var klar i februari 2018 och en andra bättre realisering med utökade och något korrigerade data var klar i oktober 2019. Realiseringen från 2019 är den som gäller idag, men ifall bättre absoluta data eller relativa data eller bättre landhöjningsmodeller tas fram kan det i framtiden skapas nya realiseringar.

Table of contents

RG 2000

1 Introduction

There has been a tremendous development in surveying engineering over the last decades, where Real-time kinematic (RTK) positioning with a network of Continuously Operating Reference Stations (CORS) has become available in practically all European countries. The so-called Network RTK is nowadays a standard tool for surveyors. While the uncertainties from densified Network RTK networks for construction work are approaching the sub-centimeter level, also in the vertical (relative to the ellipsoid), this high accuracy may easily get lost while converting the Global Navigation Satellite System (GNSS) heights to "gravity related heights" in the national height frame using a geoid model. Therefore, surveyors are constantly asking for more precise geoid models.

Thanks to the recent dedicated satellite gravity field missions (CHAllenging Minisatellite Payload - CHAMP, Gravity Recovery And Climate Experiment - GRACE and Gravity field and steady-state ocean circulation explorer - GOCE), the improvements in global geopotential models is on the same level as the developments in GNSS, with an uncertainty at the 1 cm level for a resolution of about 100 km. However, for precise geoid models that surveyors are asking for, we need accurate terrestrial gravity observations with much higher spatial resolution (typically 3-5 km spacing). Apart from additional gravity observations, also quality assurance of existing gravity data is needed. In this perspective, a new modern gravity system and the renovation of the high order gravity network is considered as a moderate strategic investment which provides a firm foundation for further activities.

While developing the strategic plan for Geodetic infrastructure in Sweden in 2010 *(Lantmäteriet 2010)*, it was thus concluded that gravity observations will be a major task for the years to come. In that perspective, it was also decided to establish a new gravity reference network, and to develop a new national reference frame for gravity. This work was facilitated by the fact that Lantmäteriet owns an absolute gravimeter since autumn 2006 and has since then collected the best possible observations with today's technique at 13 stations in Sweden.

In precise geodetic work, the epoch of observations and epoch of geodetic reference frames are of outmost importance. Due to its location in to the Fennoscandian postglacial rebound (PGR) area, Sweden is, however, subject to crustal deformations with a maximum land uplift of about 1 cm/year in an area between the cities of Umeå and Skellefteå. Hence, the epoch must be thoroughly considered. It was decided to name the new gravity frame RG 2000 (Figure 1), with land uplift epoch 2000, to be compliant to the already existing national reference frames RH 2000 and SWEREF 99 in height and 3D, respectively (*Kempe et al 2016).*

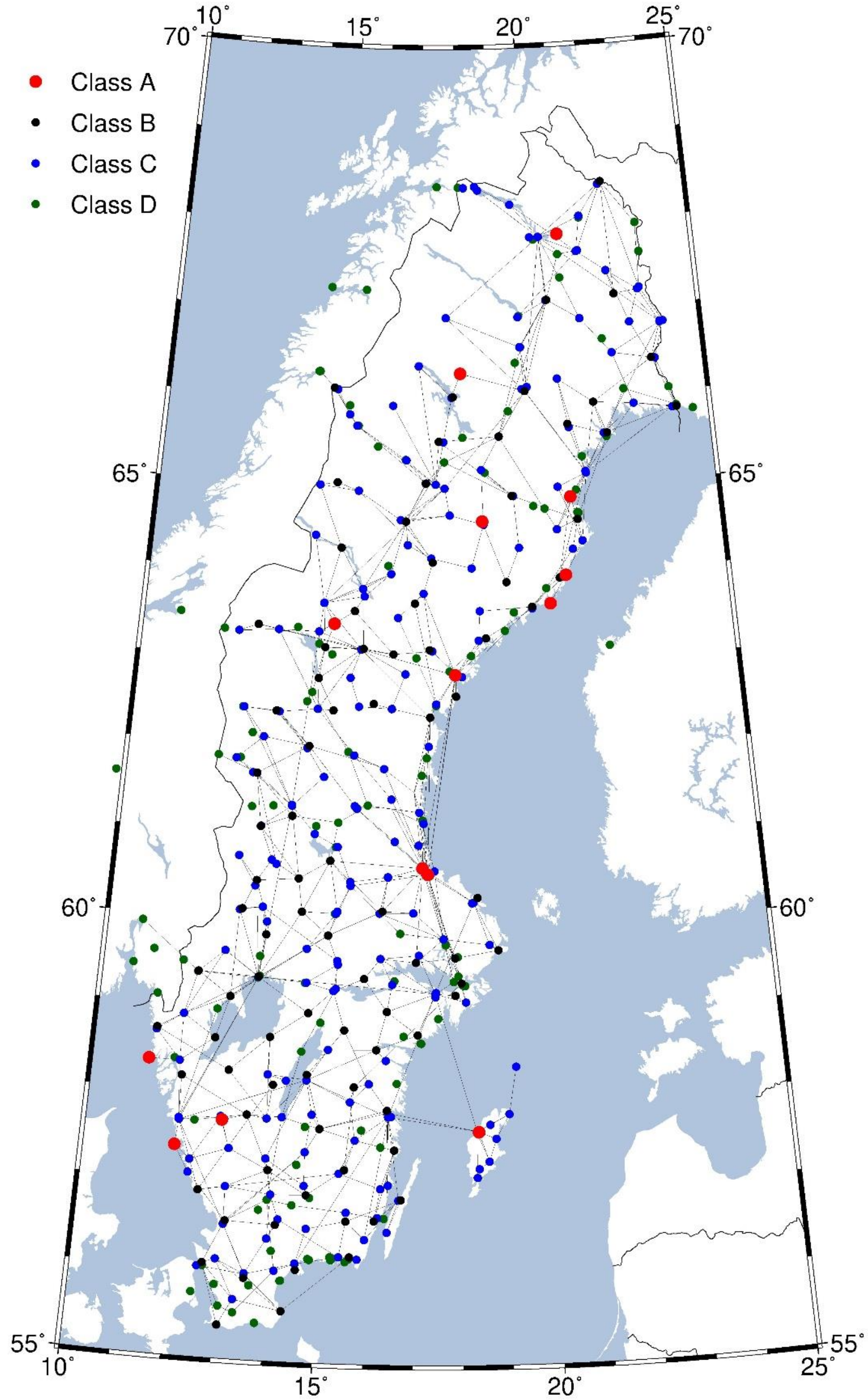

Figure 1: *The RG 2000 gravity network. Red dots are Class A points, black dots Class B points, blue dots Class C points and green dots Class D points. The grey lines show how the Class A, B and C points are connected by relative gravity observations.*

The previous Swedish gravity system, RG 82 *(Haller, Ekman 1988; Engfeldt 2016a)*, was based on four absolute gravity observations in Scandinavia *(Cannizzo, Cerutti 1978)* in 1976 by the Italian absolute gravimeter IMGC (Istituto di Metrologia Gustavo Colonnetti). Although the gravity level of this system in land uplift epoch 1982.0 agrees surprisingly well with RG 2000 (some 30 µGal difference after land uplift corrections, where 1 Gal = 0.01 m/s^2), a considerable improvement is possible with modern instruments, which will be shown in this report.

2 The situation before RG 2000

Before RG 2000 there were two old gravity systems still in use in Sweden *(Engfeldt 2016a)*, RG 82 and RG 62.

About 75% of the terrestrial gravity observations used as a basis for geoid determination were originally measured relative to the RG 62 network. Therefore, it was reasonable to consider also RG 62 while establishing a new reference frame for gravity, and if possible, find common points to facilitate the development of improved transformations between the existing RG 62 and RG 82, and the new RG 2000 gravity system.

Between 1976 and 2009, 20 points suitable for absolute gravimeters were established all over Sweden. One of them, Göteborg AA, was only used in 1976 (with the Italian instrument IMGC for RG 82) and in 1993 (with the Finnish JILAg instrument, see Section 5.3) when it was decided to abandon it for the recently established points Onsala AN and AS. The point Mårtsbo AA was also included in RG 82 and is the first one in Sweden where an absolute gravimeter has observed. One point, Onsala AB, has until now never been used as there are two other, better suited points in the same building. Therefore, Onsala AB has naturally no g-value in RG 2000. The point Holmsund AA, which was established in connection to the GNSS project "Nordost-RTK", was not observed before the RG 2000 campaign started. Then it has been observed in June 2012 with an A10 and in June 2019 for the first time with a FG5X (see Subsection 2.4.14).

These excellent points will consequently be the foundation of RG 2000 (see Chapter 4).

In the following Sections, the previous Swedish gravity systems are presented. First, the First Order gravity Network from the 1940s, of about digitally there has been almost nothing to be found until now. Second, RG 62, from which all the included points now has got a value in RG 2000. Third, RG 82, from which most of the observations have been used also in RG 2000. To make the story chronological, the Section about the land uplift gravity lines is placed between RG 62 and RG 82. Already in the 1990s the first FG5 visited Sweden and before the observations dedicated to RG 2000 started, there were 13 stations where FG5 had observed. These points have also got a Section of their own. There are other gravity base points in Sweden, established by other organizations and they have also got their own Section here. Finally, a Section in this Chapter is about the reconnoitering in 2011, when the author visited almost all of the still existing gravity points of higher order.

2.1 Base points from 1943-1948

Between 1943 and 1948, 35 base points for gravity were established by Bror Wideland and they formed a First Order gravity Network. The used instrument was the by then newly invented Nørgaard gravimeter, which was a better instrument than the previously used pendulums. The mean error after adjustment was with two exceptions between 0.25 and 0.51 mGal *(Wideland 1946 and 1951)* and the points were connected to Potsdam (see Subsection 2.2). The names of the base points and their g-values can be found in Table 30 in Appendix 2 *(Wideland 1946 and 1951)*. Three conditional adjustments were performed. First, the 17 points observed in 1943-44, where Stockholm, Säter and Uddevalla were used as fixed points and considered free from errors. Second, the 6 most southern points observed in 1945-1948, excluding Visby, with the previously determined Stockholm, Säter and Uppsala used as fix points. Third, with the rest of the points observed in 1945-1948, excluding Visby, with Ånge used as fixed point. According to *Wideland (1951)* Visby had been determined definitively earlier, but there is no information about how.

2.2 RG 62

The RG 62 system was established between 1960-1966 with 185 points situated in Sweden and more than 30 points situated in Finland, Norway or Denmark, mainly using the Worden Master gravimeter 544 *(Pettersson 1967)*. The points on the west coast were observed in 1962 by three Worden and two Worden Master gravimeters by two Italian scientists from Osservatorio Geofisico Sperimentale in Trieste in connection to the establishment of the European Calibration System (ECS) (*Gantar, Morelli 1962*). The absolute level of this system was taken from the three points København (Buddinge), Oslo A and Bodø A (Bankgatan), obtained from the establishment of ECS. Note that none of these three points are situated in Sweden. Also note that this absolute level is based on five pendulum observations in Potsdam in 1898-1904 by Kühnen and Furtgeführt (*Wideland 1946*). It is well-known that there is a large bias in this determined level (for an overview, see *Ekman, Olsson 2017*) and due to that, RG 62 is separated with about 14.6 mGal from RG 2000. Moreover, even if the Worden and Worden Master gravimeters were of very much higher quality than their predecessor, the Nørgaard gravimeter, their quality was quite poor when compared to later generations of gravimeters such as the LaCoste & Romberg (LCR) and the Scintrex CG5 instruments used for RG 2000. This means that the old relative measurements may have uncertainties of up to 0.2 mGal.

The network originally consisted of 185 points (excluding many points in Denmark, Finland and Norway) and formed 24 loops. Ten of the points were part of the European Calibration Line and there were five connections to the Finnish first order gravity network which was measured about the same time as RG 62. Despite RG 62 covered the area of Sweden well, due to the formation of loops large gaps remained in the coverage, where the nearest point was more than 100 km away from the centre of a loop area. Of the 182 points, only 20 were marked with a benchmark, so they could easily be identified. Unfortunately, almost all of these benchmarks are either destroyed, moved or unsuitable for further observation. Many of the points are situated on church steps, but unfortunately the place on the step is precisely described for very few of them, unless "in the middle of the stone slab" counts as precisely described. Note that the point 01 00 01J Bromma airport was destroyed already before *Pettersson (1967)* was printed.

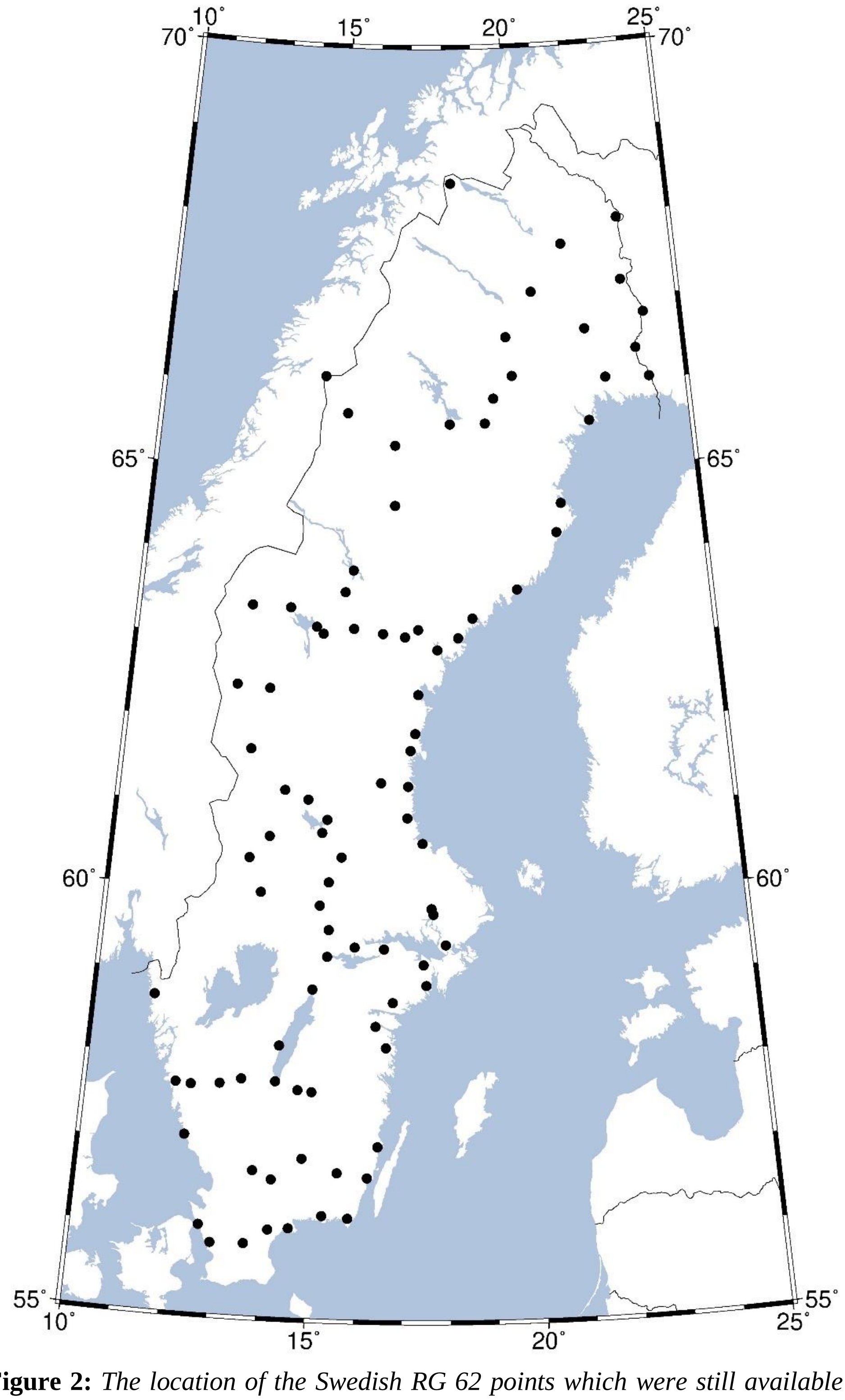

Figure 2: *The location of the Swedish RG 62 points which were still available in 2011.*

This network was also known as the First Order Network in Sweden and the detail (or terrestrial) gravity network used for geoid computation was called the Second Order Network. After RG 82 started to be built up, the RG 62 network was still by many people called the First Order Network, even when a new First Order Network for RG 82 was on the way. In old protocol books observations on the points in this network always have a "1op" (First Order point) after the name of the point itself. Somewhere along the way, the "o" got lost and nowadays it is simply "1p" after their name when mentioning them and trying to separate them from points in the RG 82 networks. So, whenever “1p” is written somewhere further down in this report, it means that the point in question was/is a part of RG 62.

A few RG 62 points were included in the old gravity system from the 1940s (see Table 30 in Appendix 2). It is clear that at least the points RAK 02, Örebro castle, Varberg (Apelviksåsen A), Vislanda, Uppsala A or B, Särna new church, Bollnäs Åsen, Östersund new church, Sollefteå church, Luleå cathedral, Gällivare church and Kiruna church were included there. It is also clear that the points in the old gravity system Nässjö I, Nässjö II, Årjäng, Hoting, Storuman, Bastuträsk and Arvidsjaur are not the same as the points in or close to these towns/villages used in RG 62. The old points in Karlstad (in that case Karlstad cathedral), Eskilstuna, Stöllet (in that case Norra Ny church) and Sundsvall (in that case N Stadsberget) are in ECS 62 less than 1 mGal from points in RG 62 and their value there. But, if they are the same or not is difficult to determine, since there are no point descriptions for these old points and the text in both *Wideland (1946 and 1951)* and *Pettersson (1967)* is telling too little about them.

All the points of RG 62 situated in Sweden except 01 00 01J Bromma airport got values in RG 2000 and so got 1 point situated in Denmark, 2 points situated in Finland and 13 points situated in Norway (which means the junction points and their spare points). Those RG 2000 values can be found including a discussion about the quality of RG 62 in Subsection 10.4.2. More about RG 62 can be found in Appendix 3.

2.3 The land uplift gravity lines

The Fennoscandian PGR (Figure 3) has been a subject of scientific interest since the 17th century (*Ekman 2009)*.

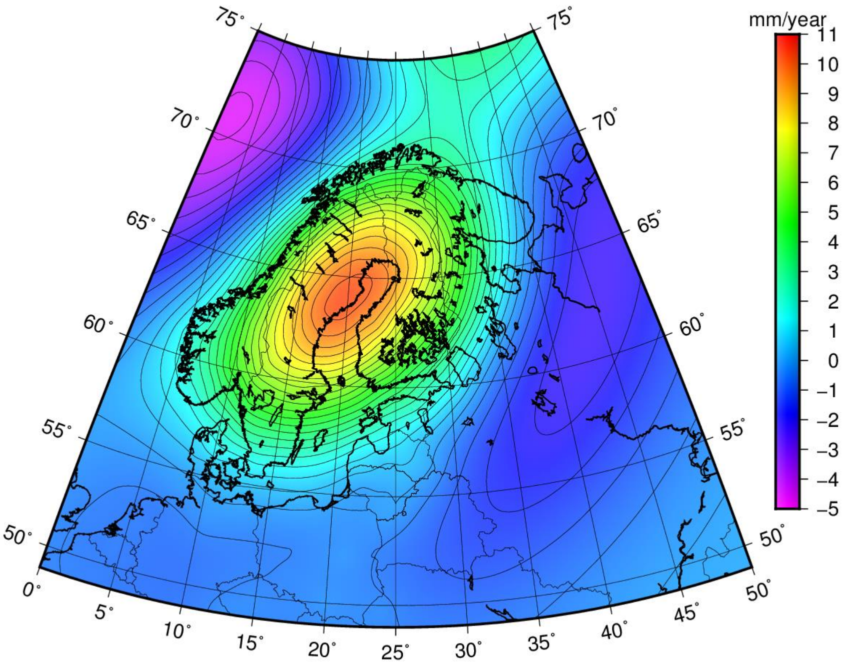

Figure 3: *The land uplift model NKG2016LU_abs (Vestøl et al 2019) for northern Europe.*

From the perspective of gravity observations, it started in 1966 when the first Fennoscandian land uplift gravity line was established (*Kiviniemi 1974*). The purpose was to better understand the PGR process by determining the relation between gravity change and geometric land uplift ($\dot{g}/\dot{h}$) from observations. The relation would help identifying to what extent the PGR is an elastic process, or if there is an inflow of mantle material to the PGR area.

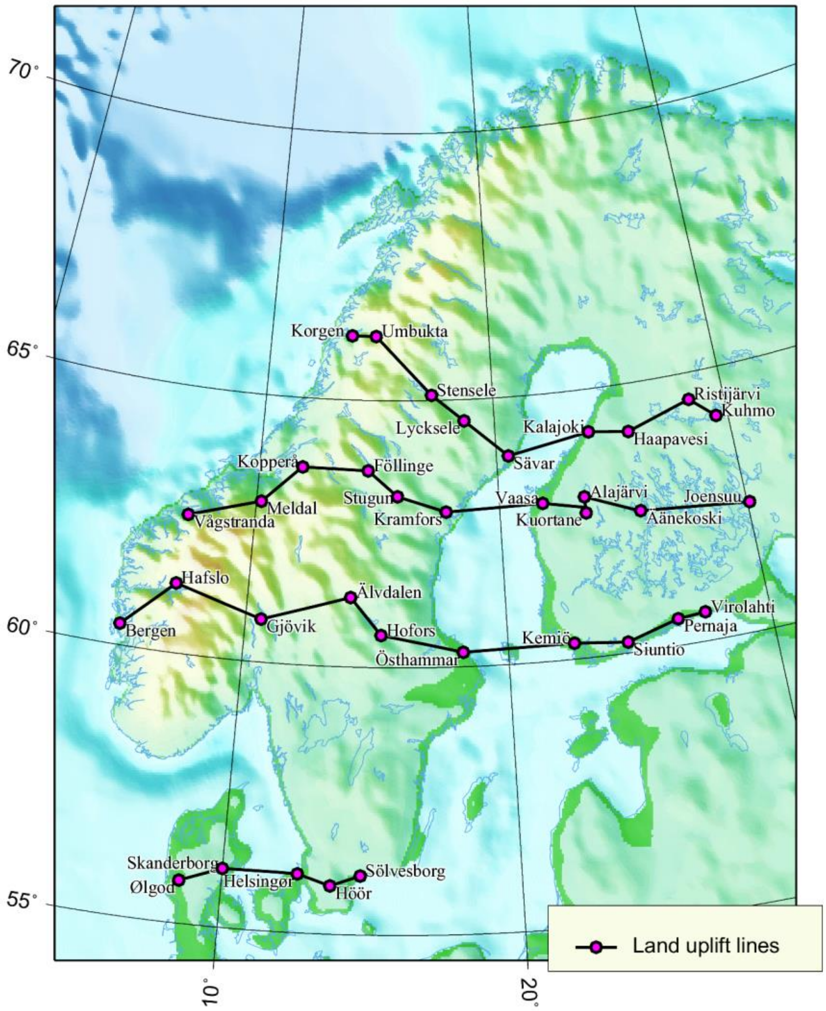

Figure 4: *The location of the Fennoscandian land uplift gravity lines. From North to South: the 65th (Korgen-Kuhmo), the 63rd (Vågstranda-Joensuu), the 61st (Bergen-Virolahti) and the 56th line (Ølgod-Sölvesborg).*

In total, four gravity lines were established (see Figure 4), where the 63rd degree latitude line has been observed most times, with observations of the complete line almost every fifth year between 1966 and 2003 (see Figure 5). For these observations, only LCR D- and G-models were used. In total, about 20 instruments participated in one or more of these observation campaigns. All raw data and computed results from the observations between 1966 and 1984 were published in *Mäkinen et al (1986)*. With computed results it means a corrected (for height, temperature, pressure and tidal effects) average value of the difference between two points observed by one specific instrument in one specific campaign. A similar report is in progress including the raw data and the computed results from the measurements between 1985 and 2003. However, the conclusions based on them can be found in *Mäkinen et al. (2005)*. The 12 Swedish points along the land uplift gravity lines and its spare points are all included in RG 82. More about this can be read in *Engfeldt (2016a)*.

Figure 5: *Observations in Joensuu (Finland) along the 63rd degree line in 2003 with two Swedish (G54 and G290) and two Norwegian (G45 and G378) gravimeters.*

2.4 RG 82

The RG 82 system and the Zero Order Network in RG 82 were established in 1981-1982 with the use of two LaCoste & Romberg model G gravimeters, G54 and G290 *(Haller, Ekman 1988)*. It is based on four absolute gravity observations (Mårtsbo AA and Göteborg AA in Sweden, Sodankylä in Finland and København (Gamlehave) in Denmark) by the Italian instrument IMGC in 1976 *(Cannizzo, Cerutti 1978; Haller, Ekman 1988)*. The absolute level of RG 82 has lately proved to be much better than expected, with a bias of less than 30 µGal compared to modern absolute observations, if the land uplift is accounted for (see Section 12.1). The Zero Order Network consists of the two Swedish points observed with IMGC (and its spare points), the 12 Swedish points (and its spare points) on the four NKG land uplift gravity lines (see Section 3.2) and 11 new points (and its spare points). The points on the land uplift gravity lines got a name after a village nearby and then one letter after, for example Älvdalen A for the main point and Älvdalen B for the spare point. The new points instead got a name after a village/town nearby and then “N” and one letter after, for example Jävre NA for the main point and Jävre NB for the spare point.

The First Order Network in RG 82 is not a network in any real meaning, since only 15 points have been measured from more than one starting point. However, it is still a densification of the Zero Order Network, consists of 149 points and was finished in October 2002 *(Engfeldt 2016a)*. Exactly as for the Zero Order Network, the LCR gravimeters G54 and G290 have been used here. With one exception (Stekenjokk), all the points have been observed at least twice with both these instruments. These points got a name after a town/village nearby, for example Arvika or Saxnäs.

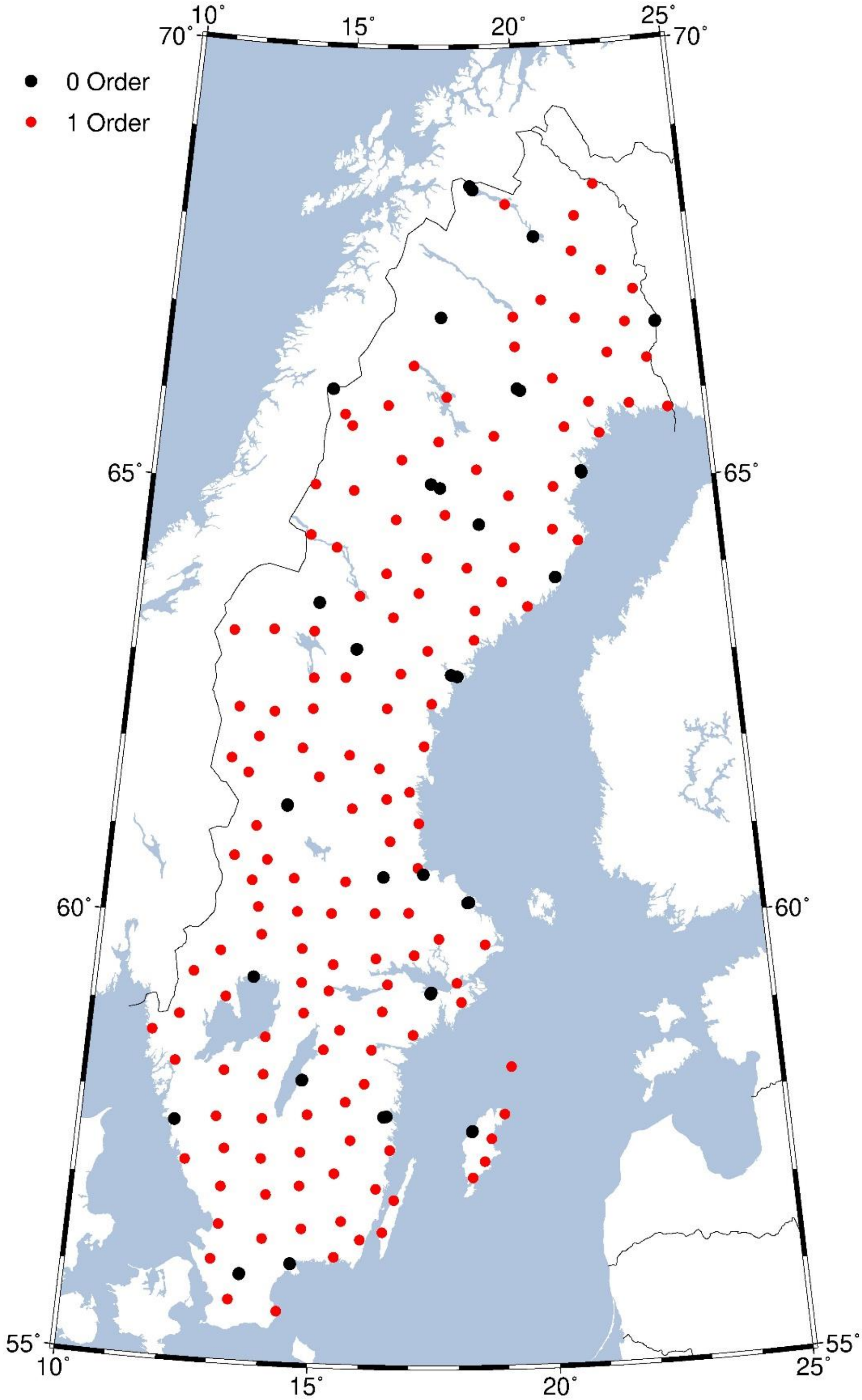

Figure 6: *The location of the RG 82 points still available in 2017. Black dots are Zero Order Network points and red dots are First Order Network point.*

Unlike the observations for the RG 62 Network and the RG 82 Zero Order Network, the observations for the RG 82 First Order Network were spread through eventually 19 years between the first and the last observation. About two thirds of the observations were performed around 20 years after the epoch of the network. This means that here a land uplift model was needed. The used model was the Ekman/Mäkinen model and the factor for converting the land uplift to a g-value was -0.220 µGal/mm.

2.5 FG5 points

When the RG 2000 project started, there were 17 points in Sweden where an FG5 instrument had observed. The points are located at 13 different places all over the country, which will be described in the following Subsections.

2.5.1 Mårtsbo AA and AB

Mårtsbo AA (Figure 7) is the only FG5 point which was included in RG 82 and the first point in Sweden where absolute gravity observations have been performed. This was when the Italian instrument IMGC visited in 1976 (*Cannizzo, Cerutti 1978*). The point has been visited by IMGC, NOAA (National Oceanic and Atmospheric Administration, Boulder, Colorado, USA), BKG (Bundesamt für Kartografie und Geodäsie, Frankfurt, Germany), IfE (Institut für Erdmessung, Leibniz University, Hannover, Germany), Lantmäteriet, FGI (Finnish Geodetic Institute, Masala, Finland) and IGiK (Institute of Geodesy and Cartography, Warsaw, Poland). Mårtsbo AA is connected relatively to the FG5 points Kramfors AA, LMV AA and Mårtsbo AB, the A10 point Boda Bruk AA, the RG 82 Zero Order Network points Hofors A, Mårtsbo B and Östhammar A, the RG 82 First Order Network points Arbrå, Hybo, Solna, Uppsala, Vallvik, Voxna and Åmot and the RG 62 point Skutskär 1p.

Mårtsbo AB (Figure 7) was built the same year as Mårtsbo AA, but was first used for absolute gravity observations in 2007 when a comparison was performed between the instruments FG5-220 (IfE) and FG5-233 (Lantmäteriet). Mårtsbo AB is connected relatively to Mårtsbo AA and Mårtsbo B.

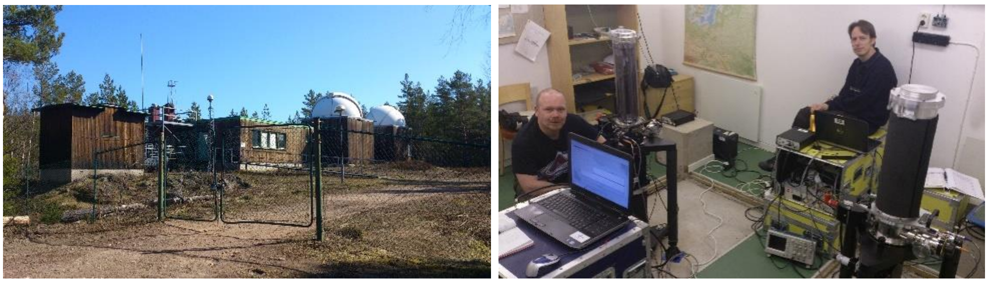

Figure 7: *Left: Mårtsbo, the building. Right: Comparison in Mårtsbo in 2015. FG5-233 is at Mårtsbo AA (right, next to Andreas Engfeldt) and FG5X-221 (FGI) is at Mårtsbo AB (left, next to Jyri Näränen).*

2.5.2 Onsala AA, AC, AN and AS

At Onsala Space Observatory (belonging to Chalmers Technical University in Gothenburg) there are two gravity houses. The old gravity house has one concrete pillar for absolute gravity with the two points Onsala AN and Onsala AS (Figure 9). In 2009 the new gravity house was built with two pillars for absolute gravity. While point Onsala AA is on one pillar the points Onsala AB and Onsala

AC are on the other (Figure 8). The point Onsala AB has never been used to date. The new house is also the home of the only superconducting gravimeter in Sweden. The first observation in Onsala took place in 1993 when FGI observed at a point between Onsala AN and AS with their JILAg (the predecessor of FG5). In 2013, the last observations in the old house took place, when Lantmäteriet's FG5-233 observed there. Onsala AA, AN and AS were observed with the same instrument around that time to get an as strong connection between the old and new points as possible. IfE observed on Onsala AN and AS from 2004 to 2008, but all its data is transferred to Onsala AA. Onsala AA is apart from being connected to the other points in Onsala (included the new points Onsala A and B) also connected relatively to the RG 82 Zero Order Network point Göteborg NB, the RG 82 First Order Network point Veddige and the RG 62 point Varberg 1p. Onsala AC is only connected relatively to points in Onsala.

Figure 8: *Left: The new gravimeter building in Onsala. Right: FG5-233 observing at Onsala AA in 2015, the Scintrex relative gravimeter is standing at Onsala AC.*

Onsala AN and/or AS have been visited by FGI, NOAA, BKG, IfE, NMBU (The Norwegian Agriculture University, Ås, Norway) and Lantmäteriet. Onsala AA and/or AC have been visited by Lantmäteriet, NMBU, IfE and IGiK. Onsala AN and AS are only connected relatively to points in Onsala.

Figure 9: *Left: The old gravimeter building in Onsala. Right: FG5-233 observing at Onsala AS in 2013, Onsala AN is on the other side of the pillar, hidden behind the instrument on the photo.*

2.5.3 Skellefteå AA

Skellefteå AA (Figure 10) was built in 1991 and the first observation was performed by FGI and its JILAg-instrument in 1992. The point has been visited by FGI, NOAA, BKG, IfE and Lantmäteriet. Skellefteå AA is connected relatively to the A10 points Bureå AA and Sävar AA, the RG 82 Zero Order Network points Jävre NA and Jävre NB, the RG 82 First Order Network points Burträsk and Lidträsk and the new point Skellefteå B (a benchmark just outside of the hut).

Figure 10: *Left: The building Skellefteå AA. Right: Observation with FG5X-233 at Skellefteå AA in 2019.*

2.5.4 Kiruna AA

Kiruna AA (Figure 11) was built in 1995 and the first observation was performed by NOAA and its FG5-instrument in 1995. The point has been visited by NOAA, BKG, IfE, Lantmäteriet, NMBU and IGiK. Kiruna AA is connected relatively to only one other point included in RG 2000, which is the RG 82 Zero Order Network point Jukkasjärvi NA (which is connected relatively to 12 other points in RG 2000).

Figure 11: *Left: The building Kiruna AA. Right: Observation with FG5-233 at Kiruna AA in 2015.*

2.5.5 Kramfors AA

Kramfors AA (Figure 12) was built in 2003 and the first observation was performed by IfE and its FG5-instrument in 2003. The point has been visited by IfE and Lantmäteriet. Kramfors AA is connected relatively to the FG5 points LMV AA and Mårtsbo AA and the A10 point Kramfors AB.

Figure 12: *Left: The building Kramfors AA. Right: Observations with FG5-233 at Kramfors AA in 2013.*

2.5.6 Östersund AA

Östersund AA (Figure 13) was built in 2003 and the first observation was performed by IfE and its FG5-instrument in 2003. The point has been visited by IfE, Lantmäteriet and NMBU. Östersund AA is connected relatively to the A10 points Hammerdal AA and Östersund AB, the RG 82 Zero Order Network point Föllinge B, the RG 82 First Order Network point Krokom and the new point Östersund B (a benchmark just outside the hut).

Figure 13: *Left: The building Östersund AA. Right: Observation with FG5-233 at Östersund AA in 2008.*

2.5.7 Arjeplog AA

Arjeplog AA (Figure 14) was built in 2003 and the first observation was performed by IfE and its FG5-instrument in 2003. The point has been visited by IfE, Lantmäteriet and NMBU. Arjeplog AA is connected relatively to the A10 point Kåbdalis AA, the RG 82 First Order Network point Arjeplog and the new point Arjeplog B (a benchmark just outside the hut.

Figure 14: *Left: The building Arjeplog AA. Right: Observation with FG5-233 at Arjeplog AA in 2013.*

2.5.8 Visby AA

Visby AA (Figure 15) was built in 2004 and the first observation was performed by IfE and its FG5-instrument in 2004. The point has been visited by IfE and Lantmäteriet. Visby AA is connected relatively to the RG 82 Zero Order Network point Visby NA, the RG 82 First Order Network point Garde and the new point Visby D (a benchmark just outside the hut).

Figure 15: *Left: The building Visby AA. Right: Observation with FG5-233 at Visby AA in 2011.*

2.5.9 Smögen AA

Smögen AA (Figure 16) was built in 2004 and the first observation was performed here was by NMBU and its FG5-instrument in 2004. The point has been visited by NMBU and Lantmäteriet. Smögen AA is connected relatively only to one other point in RG 2000, the RG 82 First Order Network point Uddevalla.

Figure 16: *Left: The building Smögen AA. Right: Observation with FG5-233 at Smögen AA in 2013.*

2.5.10 LMV AA

LMV AA (Figure 17) is a benchmark on the concrete floor in a shelter room in the Lantmäteriet headquarter in Gävle. The point was first observed in 2006 by Lantmäteriet when FG5-233 arrived from the manufacturer in the USA. The point has been visited only by Lantmäteriet. LMV AA is connected relatively to the FG5 points Kramfors AA and Mårtsbo AA, the A10 points Boda Bruk AA, Bollnäs AA, Grytnäs AA, Husby Ärlinghundra AA, Leksand AA and Svinnegarn AA, the RG 82 Zero Order Network points Hofors B and Östhammar A, the RG 82 First Order Network points Tärnsjö, Uppsala, Vallvik and Åmot and the RG 62 point Skutskär 1p. After the first realization of RG 2000 was done, LMV AA has also been connected relatively to the RG 62 point Hamrånge 1p and the new point LMV Pol 7 (a pipe in a large stone, 100 m south of the building.

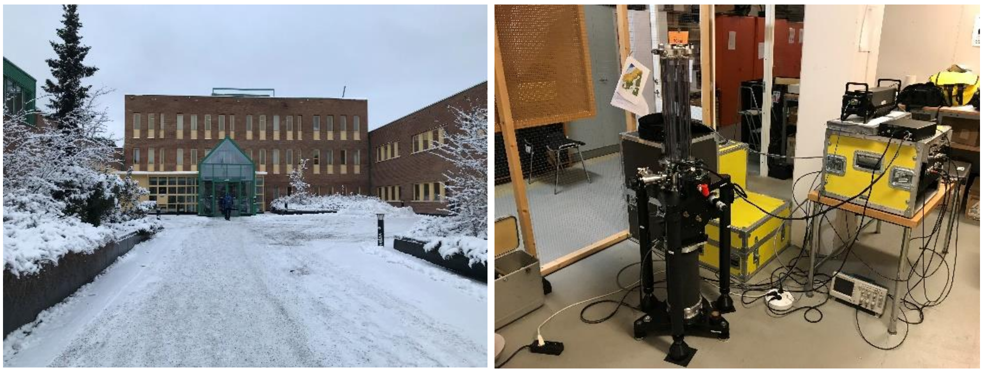

Figure 17: *Left: The headquarter of Lantmäteriet where LMV AA is situated. Right: Observation with FG5X-233 at LMV AA in 2019.*

2.5.11 Ratan AA

Ratan AA (Figure 18) was built in 2007 and the first observation was performed by Lantmäteriet and its FG5-instrument in 2007. The point has been visited only by Lantmäteriet. Ratan AA is connected relatively to the A10 points Hörnefors AA and Sävar AA, the RG 82 First Order Network point Lövånger and the new point Ratan B (a benchmark right outside the hut). After the first realization of RG 2000, Ratan AA has also been connected relatively to the RG 62 point Nysätra 1p.

Figure 18: *Left: The building Ratan AA. Right: Observation with FG5-233 at Ratan AA in 2015.*

2.5.12 Lycksele AA

Lycksele AA (Figure 19) was built in 2007 and the first observation was performed by Lantmäteriet and its FG5-instrument in 2007. The point has been visited only by Lantmäteriet. Lycksele AA was in the first RG 2000 realization connected relatively only to 1 other point, the RG 82 Zero Order Network point Lycksele A. After the first RG 2000 realization, Lycksele AA has also been connected relatively to the new point Lycksele D (a benchmark right outside of the hut).

Figure 19: *Left: The building Lycksele AA. Right: The first observation with FG5-233 at Lycksele AA in 2007.*

2.5.13 Borås AA

Borås AA (Figure 20) is a benchmark on the concrete floor in a large industrial building belonging to RISE (Research Institute of SwEden). The point was first observed in 2003 by IfE. The point has been visited by IfE and Lantmäteriet. Borås AA is connected relatively to the A10 point Ulricehamn AA, the RG 82 First Order Network points Borås and Svenljunga and the RG 62 point Borås 1p. There are photo restrictions at the place, but RISE has given us permission to publish the photos in Figure 20.

Figure 20: *Left: The building at RISE where Borås AA is situated. Right: Observation with FG5-233X at Borås AA in 2017.*

2.5.14 Holmsund AA

Holmsund AA (Figure 21) was built in 2007 in connection to the Network RTK project "Nordost-RTK" and was supplied with an AG pillar in concrete. Since the nearby station Ratan was built at the same time, there was no need to observe this point for PGR studies with an absolute gravimeter. Therefore, it was not used until the second A10 campaign of the RG 2000 project in June 2012, when the Polish A10-020 from IGiK visited the station. In June 2019 it was observed with FG5X-233 for the first and so far only time, but it is planned to be observed with FG5X-233 again.

Figure 21: *Left: The building Holmsund AA. Right: The first observation with FG5X-233 at Holmsund AA in 2019.*

2.6 Other available gravity points

SGU (Sveriges Geologiska Undersökning, the Geological Survey of Sweden) established around 2005 about 30 so-called base points, which were connected to RG 82 points with relative gravity observations. Most of these points had no proper marking more than some measures, but there are a few exceptions where benchmarks from Lantmäteriet had been used, exactly as for most of the RG 82 points. Seven points which looked good from the point sketch and the attached photos were checked during the reconnoitring in 2011 by the author (see Section 2.7). Two of these, later called Överturingen AA and Tärendö AA, then proved to be good for A10 observations, so they were observed in 2012 and 2013 respectively with A10 and became a part of the RG 2000 network (see Figure 22). Överturingen AA is connected relatively to the A10 points Hede AA and Svenstavik AA and the RG 82 First Order Network point Rätansbyn. Tärendö AA is connected relatively to the A10 point Karesuando AA and the RG 82 First Order

Network points Junosuando and Pajala. The remaining SGU points reconnoitred in 2011 have not been observed by Lantmäteriet and have therefore no status in RG 2000.

Figure 22: *A10 observations at Överturingen AA in 2012 (left) and at Tärendö AA in 2013 (right).*

2.7 Reconnoitring the existing points

Apart from that the absolute level of RG 62 was wrong (see Section 2.2) and that it was observed by old-fashioned instruments, one reason mentioned for establishing RG 82 was that in the early 1980s about 1/3 of the RG 62 points were destroyed (see Figure 2 in Section 2.2). In advantage it was known that the rate of destroyed points in RG 82 was low when RG 2000 was about to become established (see Figure 6 in Section 2.4), but for the work with RG 2000 it was important to know both how many points in RG 82 and in RG 62 which still were existed. In 2011, the author checked almost all the existing gravity points of the higher order (which means the ones in Section 2.2, Section 2.4 and Section 2.5) and measured their position as good as it was possible at the time. During these journeys, also some additional churches and SGU base points (see Section 2.6) were visited in order to see if these points could replace the RG 82 (or RG 62) points in the neighbourhood.

Totally 49 RG 82 Zero Order Network points, 137 RG 82 First Order Network points and 103 RG 62 points were found. Of these, it was noticed which points were excellent for A10 observations and which points could be used for tying new A10 points together with the RG 82 network. It was also noticed which points were not good enough to use for further relative gravity observations. In addition, 17 points were found destroyed and 10 points were not found. Additionally, 7 SGU base points and 20 possible new points (mainly as possible points for replacing the few missing RG 82 points) were visited, of which some were later used for A10 observations.

Of those 10 points not found in 2011, four RG82 First Order Network points have been found later and have then been observed again with relative gravity observations. These are Aneby, Lagan, Laholm and Ludvika. The RG 82 points Gotska Sandön (an island and National Park in the Baltic Sea north of Gotland) and Kastlösa were not visited in 2011. While it was clear that Gotska Sandön should not be observed with an A10, Kastlösa was not visited by mistake. The new point description was not in the dossier since it could not be found in the Digital Geodetic Archive at that time. Found later, it was then visited and observed with relative gravity observations in 2016. All RG 62 points situated at airports or on bridges were intentionally left unvisited, since it was clear that they were either unusable or destroyed.

Figure 23: *Photos from the reconnoitering. Left: Ljusnarsberg AA, an RG 62 point which fitted perfectly for A10 observations. Right: Lövånger, an RG 82 First Order point which surface is leaning too much for an A10 and even for a relative gravimeter.*

After the reconnoitring, the RG 82 First Order Network point Rättvik has been destroyed by construction work. The area surrounding the RG 82 First Order Network point Säffle, which was observed with an A10 in 2011 and then became Säffle AA, was changed in 2014-15. A single gravity observation from 2017 by our best relative gravimeter Scintrex CG5-41184 (later in the report only called CG5-1184) indicates though that the value has not changed much and thus the point can still be used.

Figure 24: *Säffle AA in 2011 (left) and in 2015 (right).*

3 Definition and realization of RG 2000

In the two Sections below, the definition and the realization of RG 2000 is presented.

3.1 Definition of RG 2000

RG 2000 is the new gravity network and gravity system of Sweden. It is the gravity reference level as obtained by absolute gravity observations according to international standards and conventions. The PGR epoch is 2000.0, which means January 1, 2000. It is a zero permanent tide system. The land uplift model NKG2016LU *(Vestøl et al. 2019)* was used to get to the correct land uplift epoch. The number -0.163 (µGal/mm) *(Olsson et al 2015b)* was used to convert the land uplift to gravity change.

3.2 Realization of RG 2000

RG 2000 is realized by 343 points with an assigned gravity value and the corresponding standard uncertainty (obtained from the adjustment). The land uplift model NKG2016LU_abs *(Vestøl et al. 2019)* was used to reduce all observations to the reference epoch 2000.0. To convert the absolute land uplift to gravity change, the relation -0.163 µGal/mm was used *(Olsson et al. 2015b)*. The final values from the gravimeters A10-020 and FG5-233 were corrected with results from international comparisons (*Olsson et al. 2015a),* see further in Subsection 5.1.1 and Section 6.1.

The realization of RG 2000 should not be viewed as closed. Depending on new and improved measurements, updates of RG 2000, i.e. new realizations, are planned. The first realization was released in 2018. However, during the work on this report, a second, improved realization has already been finalized. Hence, when it is referred to RG 2000 in this report without mentioning which realization, the second realization of RG 2000 from 2019 is meant. Apart from new realizations, it will be possible to determine new points in RG 2000 in the future. Of course, this will require that the land uplift effect is handled with sufficient accuracy. But since land uplift models will most likely improve with time, this is not expected to be a significant problem. Therefore, none of the points in RG 2000 (see Figure 1) is regarded as perfect (free from errors). It will further be possible to include new absolute gravity points in RG 2000 in the future. These points might even be more accurate than the present ones.

4 The strategy

The strategy for generating and realizing RG 2000 was discussed in *Engfeldt (2016b)* and is thus only briefly summarized here. It was decided to:

- Use the FG5-observations as the foundation of the network,
- Use the A10 gravimeter to densify the network, all over Sweden and wherever possible, at points in the old RG 82 and RG 62 networks,
- Use the relative observations from RG 82, both from the Zero and First Order Network campaigns,
- To make new relative observations between the FG5 points, the A10 points and other points in the network, i.e. RG 82 points. This was necessary to ensure there are no single connected points and makes RG 2000 a real network. It was also done as a first check of the A10 observations to ensure they were not afflicted with gross errors.

5 FG5 observations

In the following Sections and Subsections, first the available FG5 observations are presented instrument by instrument. After that it is presented which FG5 observations were used in the realizations of RG 2000 and how they were used.

5.1 FG5-233

Lantmäteriet purchased in 2006 the absolute gravimeter FG5-233 from Micro-g LaCoste Inc and the first observations on Swedish ground with it was performed in October the same year at LMV AA (see Subsection 2.5.10). The purpose of purchasing the instrument was mainly to observe/monitor the land uplift, but its observations have also been used for the new gravity network RG 2000.

The Swedish standard procedure to measure absolute gravity is according to the following:

- Two orientations, 24 hours in north orientation and 24 hours in south orientation,
- 24 sets in every orientation (in 2007, 48 sets in every orientation),
- 50 drops (observations) per set,
- All observations not within the 3-sigma level are regarded as outliers and are removed directly by the g-software,
- The laser is turned on at least 4 hours before the observation starts.

The frequency of the Rubidium clock has been calibrated regularly 2-6 times per year. The frequency used for computation was interpolated linearly between the measurements. In January 2009, Lantmäteriet purchased a GPS stabilised rubidium clock, which since then has been the standard reference to compare the FG5 clock frequency to. Before that, the clock calibrations were performed in Onsala, where there is a hydrogen maser. When attending absolute gravity comparisons, the clock frequencies have also been compared and the reference frequency has then been supplied by the host of the comparison.

5.1.1 Corrections according to results from ICAG/ECAG/EURAMET

FG5-233 has participated in the following international absolute gravimeter comparisons (see Figure 25, Figure 26 and Table 1): ECAG 2007 *(Francis et al. 2010)*, ICAG 2009 *(Jiang et al. 2012)*, ECAG 2011 *(Francis et al. 2013)*, ICAG 2013 *(Francis et al. 2014)*, EURAMET 2015 *(Palinkas et al. 2017)* and EURAMET 2018 (as FG5X-233). FG5-233 has been on service/repair five times in between the intercomparisons. Due to a jump in the time series after the service in 2009-10, it was decided to correct the observations according to the results in ICAG/ECAG *(Olsson et al. 2015 and Olsson et al. 2019)*, an approach that also Herstmonceaux Geodetic Observatory follows *(Smith 2018)*. After the last two services/upgrades (it was upgraded to FG5X at the end of 2016 and after that it was on service once more), two more jumps have occurred, but since these data is not used for RG 2000, it is of no interest here. FG5-233 has also participated in two Regional ICAG's (RICAG), in 2010 and 2013, but the results from these intercomparisons have not been used. This is due to that only four instruments participated in RICAG 2010 and only six instruments participated in RICAG 2013 *(Timmen et al. 2015 and Schilling, Timmen 2016)*, in comparison to between 17 and 25 in the other intercomparisons. In none of the RICAG's, the mean level of the participating instruments was an excellent sample, even if both the RICAG's have confirmed the results from the other intercomparisons.

Figure 25: *ICAG 2013 in Walferdange (left) and EURAMET 2015 in Belval (right).*

Table 1: *The intercomparisons where FG5-233 has participated. CRV = Comparison Reference Value (see Table 2).*

Place, date	FG5-233, CRV	Operators
ECAG 2007, November 2007, Walferdange, Luxembourg	+1.0	Andreas Engfeldt, Per-Anders Olsson
ICAG 2009, September 2009, Paris, France	+1.0	Geza Lohasz, Jonas Ågren
RICAG 2010, November 2010, Wettzell, Germany	+5.8	Andreas Engfeldt
ECAG 2011, November 2011, Walferdange, Luxembourg	+4.7	Andreas Engfeldt, Jonas Ågren
RICAG 2013, January 2013, Wettzell, Germany	+3.2	Andreas Engfeldt, Holger Steffen
ICAG 2013, November 2013, Walferdange, Luxembourg	+2.2	Andreas Engfeldt, Jonas Ågren
EURAMET 2015, November 2015, Belval, Luxembourg	+2.5	Andreas Engfeldt, Per-Anders Olsson
EURAMET 2018, April 2018, Wettzell, Germany	-4.1	Andreas Engfeldt, Holger Steffen

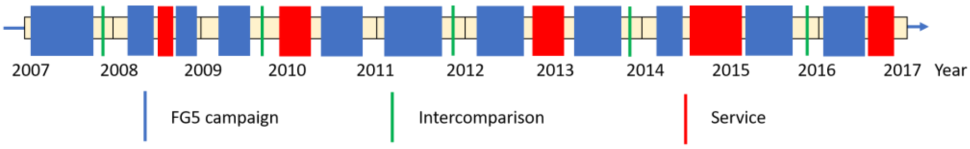

Figure 26: *Overview of the FG5-233 observation periods (blue), participation in intercomparisons (green) and scheduled service (red) for data used in the RG 2000 project.*

5.2 FG5-220

In 2003, a large Nordic absolute gravity project *(Engfeldt 2016a)* started from an initiative by Ludger Timmen, IfE, and with funding from the German Science Foundation (DFG). During the years 2003-2008 the IfE instrument FG5-220 travelled through Scandinavia and observed at most of those days existent FG5 points (see Figure 27). The results can be found in *Gitlein (2009)*. This adds another four years to the time series from the Swedish instrument, FG5-233. However, during the first year of observations unrealiable results of yet unclear reason were obtained (*Gitlein 2009*). Therefore, only observations between 2004 and 2008 were used *(see also Gitlein, 2009)*. During 2003-2004, the orientation of the observations differed a bit from point to point (see Appendix 1, Table 28). The most frequent orientation was south and then the instrument was also orientated in some other direction. During 2005-2008, the orientation was almost always both north and south at every point.

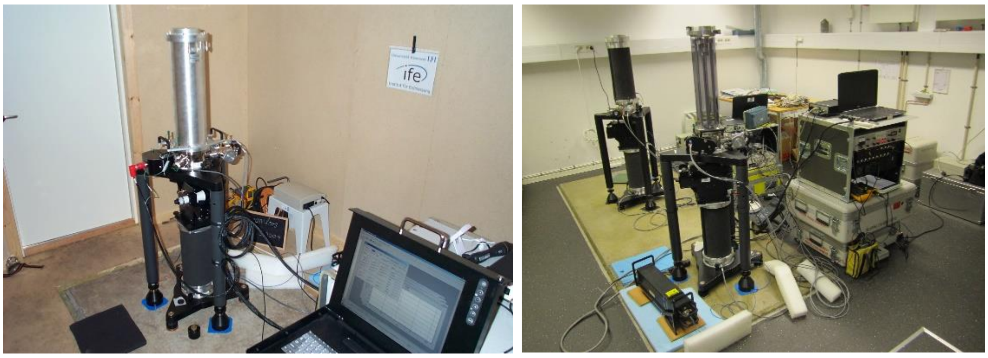

Figure 27: *FG5-220 observation in Kramfors AA (left, in 2004) and comparison between FG5-233 and FG5X-220 in Onsala AA/AC (right, in 2014).*

Table 2 shows the difference between the instruments at comparisons. At RICAG 2013 these two instruments, FG5-233 and FG5X-220, gave a value much higher than the average value, which was calculated based on measurements by five instruments on four points. FG5-233 and FG5X-220 observed at three points together resulting in a difference of 0.1 mGal between these two instruments. This difference fits very well to the ICAG 2013 result. The average value at the fourth point, however, was unfortunately biased by another instrument observing too low there, which eventually caused that the CRV of FG5-233 got higher than the one of FG5X-220. We thus refrain from using the result in our calculations. Note that the data for FG5-220 in the first RG 2000 realization was not corrected for intercomparison results, while the FG5-233 data is.

Table 2: *Differences between FG5-233 and FG5-220. CRVs: Comparison Reference Values as defined by all participating gravimeters (ICAG, ECAG) or by the reference gravimeters (RICAG); statistical values are partly not available. Note that for the last four comparisons, FG5-220 has been upgraded to a FG5X and for the last comparison, FG5-233 was also upgraded to a FG5X. * See the text above.*

Site and time	Difference (µGal) FG5#233-CRVs	Difference (µGal) FG5#220-CRVs	Difference (µGal) FG5#233-#220
Mårtsbo May 2007			-2.1
ECAG 2007, November 2007	+1.0	+2.4	-1.4
ICAG 2009, September 2009	+1.0	+1.7	-0.7
RICAG 2010, November 2010	+5.8	+3.3	+2.5
ECAG 2011, November 2011	+4.7	+1.8	+2.9
RICAG 2013, January 2013	+3.2*	+2.6*	-0.6
ICAG 2013, November 2013	+2.2	+2.3	-0.1
Onsala, May 2014			-2.4
EURAMET 2015, November 2015	+2.5	+5.2	-2.7
ECAG 2018, April 2018	-4.1	-1.5	-2.6

5.3 Other instruments

Some different organizations performed absolute gravity observations in the region in the 1990s and early 2000s *(see Engfeldt 2016a)*. FGI purchased one JILAg absolute gravimeter in the early 1990s and apart from observing a few stations regularly in Finland, Jaakko Mäkinen also observed Mårtsbo AA and the new point Skellefteå AA in 1992. In the same year it was decided by Lars Åke Haller to abandon the Göteborg AA point for Onsala. Jaakko Mäkinen then observed both these points by the JILAg to get the relative connection between them. However, the point observed in Onsala was later decided not to be used. Instead on the same block of concrete, two new points (Onsala AN and Onsala AS) were established and the observed point was in between those. During 1993 the first FG5s were constructed and two of them visited Scandinavia, the one from NOAA twice (1993 and 1995) and the one from BKG four times (1993, 1995, 1998 and 2003). They observed Mårtsbo AA, Skellefteå AA and the new points Kiruna AA, Onsala AN and Onsala AS.

In the early 2000s, FGI purchased a FG5 and after that it has observed a few times in Sweden, in Onsala 2004 in connection to the comparison where IfE and NMBU participated and in comparisons in Mårtsbo 2012, 2013 and 2015 where Lantmäteriet also participated.

In 2004, NMBU got funds to purchase a FG5 and started to observe, mostly in Norway but also in Sweden. Two points were measured in 2004 and 2005, when the author joined them for observations at the new point Smögen AA and a comparison with the IfE instrument in Onsala. NMBU also observed at Kiruna AA and Östersund AA in 2007 and at Kiruna AA, Östersund AA and Arjeplog AA in 2008. The latest time NMBU observed in Sweden was the comparison in Onsala 2010 where Lantmäteriet also participated.

None of the observations mentioned in 5.3 were included in RG 2000 as *Olsson et al. (2019)* found out that the results got worse if including any of them, mainly due to the bias between the different instrument levels.

5.4 FG5 observations used in the RG 2000 realization

We have chosen only the observations from FG5-233 and FG5-220 / FG5X-220. For information about the orientation, see Appendix 2, Table 27 and Table 28. For more information about the points, see 2.3.1-2.3.13. For a summary about the time span for the FG5 data used in RG 2000, see Table 3. The chosen observations can be found in Appendix 2 in Table 25. They are almost the same as in *Olsson et al. (2019)*, with the difference that in *Olsson et al. (2019)* the IfE observations from 2003 were included plus that a couple of outliers were removed here. Note that no observations performed with the upgraded FG5-233 (to FG5X-233) are included here.

Table 3: *The table shows the time span for the data used for RG 2000 and how many observations there were included from the two used instruments. * All observations performed at Onsala AN and Onsala AS before 2009 were transposed to Onsala AA by IfE; ** For the two last observations the instrument was upgraded to FG5X-220; *** The observation in 2008 was strangely not included in Olsson et al. (2019) and the 2018 realization, but included in the 2019 realization; **** The observation in 2015 was in the 2019 realization considered as an outlier; ***** The observation with FG5-220 was in the 2019 realization considered as an outlier.*

Name	Time span	# of Observations with FG5-220	# of Observations with FG5-233
Mårtsbo AA	2004-2016	5	21
Mårtsbo AB	2007-2016	1	7
Onsala AA	2004-2016	10+2*,**	7

Onsala AC	2009-2016	2**	4
Onsala AN	2010-2013	0	2
Onsala AS	2007-2013	0	6
Skellefteå AA	2004-2015	5	5
Kiruna AA	2004-2015	4	4/5***
Kramfors AA	2004-2013	5	4
Östersund AA	2004-2015	5	5
Arjeplog AA	2004-2013	5	4
Visby AA	2004-2013	2	4
Smögen AA	2008-2015/13	0	6/5****
LMV AA	2007-2016	0	50
Ratan AA	2007-2015	0	6
Lycksele AA	2007-2015	0	6
Borås AA	2008/13-2014	0/1*****	2

6 A10 observations

In the following Sections and Subsections, first the available A10 observations are presented instrument by instrument. After that it is presented which A10 observations were used in the realizations of RG 2000 and how they were used.

6.1 A10-020

In 2008 IGiK purchased the absolute gravimeter A10-020. Exactly like for FG5-233, the observations of A10-020 have been corrected according to the results in intercomparisons (see Figure 28). Here, the corrections were modified by IGiK and are not the ones derived in the intercomparisons but have very small differences to those only. Note that A10-020 also participated in ICAG 2009, but these results were not used for RG 2000. The first three campaigns were corrected by +5.8 µGal (the modified result in ECAG 2011 was -5.8), the fourth campaign was corrected by +4.7 µGal and the fifth campaign was corrected by +8.9 µGal. Since the A10 observations mainly take place outdoors, the observations are more sensitive to weather than the FG5 observations. The best weather for A10 is cloudy at a stable temperature and without any rain or wind. That is the reason why some weather-dependent observations are mentioned in the Subsections below, which otherwise describe the five A10-020 campaigns one by one.

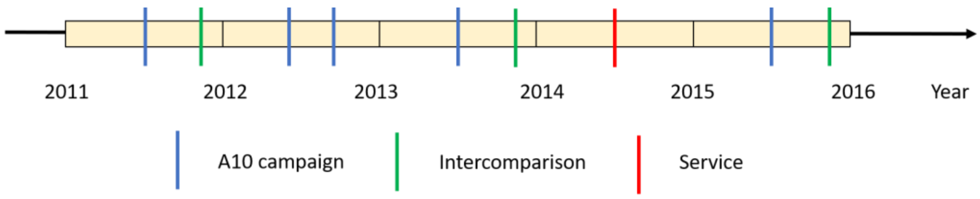

Figure 28: *Overview of the A10-020 observation periods in Sweden (blue), participation in intercomparisons (green) and scheduled service (red).*

6.1.1 The campaign in July 2011

In July 2011 A10-020 visited Sweden for observations at 12 points. This was performed as a test to see if A10 observations were suitable for determining our old outdoor points, i.e. the RG 62 and RG 82 points *(Engfeldt 2016a, Engfeldt 2016b)*. The instrument was operated by Marcin Sekowski (IGiK), with assistance of Andreas Engfeldt.

Mårtsbo AA was observed first (Figure 29) and last as a check and comparison to see how the instrument differed from FG5-233. The 11 other points were 7 points used in RG 82 (all of the First Order Network), 2 points used in RG 62 and 2 new points. The test observations were conducted such that on each point two observations were performed with the instrument oriented in two different directions, 120 degrees in between, since with this instrument the Eötvös effect is not significant *(Mäkinen 2010*), four times in the blue laser mood and four times in the red laser mood per orientation. In case the results from the two orientations differed less than 15 µGal they were considered good enough, otherwise one more orientation was observed. The result from these observations was very satisfactory, thus it was decided that at least three more campaigns with A10 should be performed.

Figure 29: *The first A10 observation in Sweden has just been performed.*

The weather was constantly changing during this campaign. It was raining at Arboga AA (but the point is covered with a ceiling), Karlstad AA, Säffle AA and Årjäng AA. At Valla AA and Vansbro AA it was instead sunny and very warm.

Figure 30: *A10 observations at Valla AA (left) and at Säffle AA (right).*

6.1.2 The campaign in June 2012

The observations started and ended at Mårtsbo AA. Apart from Mårtsbo AA, 7 RG 82 points (2 of the Zero Order Network and 5 of the First Order Network), 9 RG 62 points and 9 new points were observed. 5 of the new points were situated within 100 meters from either a less suitable or a destroyed RG 62 point (Sundsvall 1p, Örnsköldsvik 1p, Stensele A 1p, Hede 1p and Transtrand 1p).

Figure 31: *A10 observations at Sundsvall AA (left) and at Örnsköldsvik AA (right).*

It was mainly quite good weather, even if the summer/spring in the mountains came very late this year. It was a little bit of snow some meters north of Klimpfjäll AA. There was also a bit of snow around Umbukta AA and still a thick layer of ice on the lake next to this point. It rained partly during the observation at Transtrand AA and if it did not partly rain at the time of the observation at least it had rained earlier the same day at Svenstavik AA, Överturingen AA and Hede AA. Half an hour before the observation in Örnsköldsvik AA it was a thunderstorm with hail, while during the observation it was sunny.

Figure 32: *A10 observations at Umbukta AA (left) and at Klimpfjäll AA (right).*

6.1.3 The campaign in September 2012

During this campaign we observed in the southern part of Sweden. This means that we never were as far north as Mårtsbo AA. Instead of meeting in Gävle, we started to observe at the point Simrishamn AA, which was an RG 82 First Order Network point, and ended at the new point Augerum AA, close to Karlskrona. During the campaign, we observed at Onsala AA as the only check of the campaign. However, that particular observation happened to be a gross error of about 30 µGal. Apart from Onsala AA, 8 RG 82 First Order Network points, 2 RG 62 points and 16 new points were observed. 2 of the new points were situated within 30 meters from one less suitable and one destroyed RG 62 point (Tanum 1p and Veinge 1p respectively).

Figure 33: *A10 observations at Maglarp AA (left, the point with the lowest g-value in RG 2000) and at Simrishamn AA (right).*

The weather was mostly good for September, but there were exceptions. It rained and was very windy at Grinneröd AA and Eksjö AA. It also rained at Svinnegarn AA (but the point is covered with a ceiling, see Figure 34), Norrköping AA, Köpingsvik AA, Emmaboda AA, Älmhult AA and Augerum AA. At Öjaby AA it had stopped raining just before we arrived. There we got the best concordance between two different orientations that we had during all the campaigns.

Figure 34: *A10 observations at Misterhult AA (left) and at Svinnegarn AA (right).*

6.1.4 The campaign in June/July 2013

This campaign went to the very north of Sweden and our most northern high precision gravity point, Karesuando AA, was observed (see Figure 35). We started and ended at Mårtsbo AA. The FG5-point Kiruna AA was also observed as an extra check. Apart from Mårtsbo AA and Kiruna AA, 5 RG 82 points (1 of the Zero Order Network and 4 of the First Order Network, whereas Boda bruk AA had been observed before), 3 RG 62 points and 12 new points were observed. 5 of the new points were situated within 100 meters from either a less suitable or a destroyed RG 62 point (Norsjö 1p, Arvidsjaur 1p, Karesuando 1p, Bureå 1p and Leksand 1p). The new point Särna AA is situated about 200 meters from the RG 62 point Särna 1p which we originally intended to observe, but where the stones were not stable enough.

 

Figure 35: *A10 observations at Arvidsjaur AA (left) and at Karesuando AA (right, the point with the largest g-value in RG 2000 of the points observed with AG).*

The weather was mostly good, except at Luleå AA where it was both rainy and windy and at Norsjö AA where it rained and there was almost flood in the lower parts of the churchyard. It also rained a little at Sorsele AA. During the travel between Sorsele AA and Arjeplog AB it got very hot inside of the van, so we had to stop and open the lid of the A10. At the same time, we also got problems with the car, which delayed us some hours the following morning in Arvidsjaur.

 

Figure 36: *A10 observations at Gällivare AA (left) and at Kåbdalis AA (right).*

One of the points, Boda Bruk AA, was already measured in the second campaign, but remeasured here since a gross error was suspected. The suspicion was confirmed and this gross error could easily be corrected. The results from the different years differed, after the corrections, less than 1 µGal.

6.1.5 The campaign in May/June 2015

In *Engfeldt (2016b)* two different options were discussed, which we had in 2014 concerning which strategy to use continuing the work with RG 2000. They were concerning how much more we should observe with A10 and how much we should observe with relative instruments. After deciding to observe more A10 points, two different approaches were under consideration, to observe 5-12 more points (one journey) or to observe about 50 more points. Since it at that time only 1 RG 82 point was left which fulfilled the demands for an A10 point, the second approach meant that we needed to observe at 49 new points. Since we did not want any single connected points, it consequently meant a quite large amount of new relative observations. Such approach would be very time consuming.

So, it was decided that the last A10 journey would be performed during the first half of 2015, where two kinds of points would be observed: some new points and a minimum of five previously observed ones. The reasons for the latter were to make sample checks for gross errors and to investigate the repeatability of the instrument. Here, the points with the largest difference from the two orientations were chosen. This time Przemyslaw Dykowski (IGiK) operated the instrument, with assistance of Andreas Engfeldt. The campaign started and ended at Mårtsbo AA. In total 14 new A10 points (of which one was an RG 82 First Order Network point) and 6 previously observed A10 points were observed during this campaign, which means Tullinge AA, Arboga AA, Transtrand AA, Åsele AA, Stensele AA and Luleå AA.

Figure 37: *A10 observations at Solna AA (left) and at Rimforsa AA (right).*

For five of the previously observed points the new observations fit well with the previous observations. But for Transtrand AA the observations differed more than 30 µGal. In 2017, new relative observations were therefore performed between the A10 points Vansbro AA and Transtrand AA, as well as between Särna AA and Transtrand AA. Those clarified that the most reliable value was the one from 2012. During the same day as Transtrand AA was observed with A10 in 2015, the new point Voxna AA was also observed. During these observations the weather was changing from very sunny to heavy rain and heavy wind back and forward. The observation series did not fit well with each other, thus we stayed at the point for almost double the time as normal and did some extra setups. A thorough analysis together with relative observations between Voxna AA and two other A10 points, Bollnäs AA and Sveg AA, in 2017 confirmed that the gross error in Voxna AA was on the 70 µGal level.

Figure 38: *A10 observations at Stensele AA (left, the largest wooden church in Sweden) and at Haparanda AA (right).*

When we planned the campaign, 8 previously observed A10 point should be observed. However, the results for Östersund AB and Sundsvall AA were very bad, so we chose to cancel them. At Östersund AB, we even tried at two different occasions during the campaign, but both times it was extremely windy (the wind came from the west, which means from over Lake Storsjön) and the observations became unusable. During this campaign the weather was generally very bad with lots of rain and lots of wind. Only when observing the first three (Mårtsbo AA, Norrtälje AA and Solna AA) and the last two (Härnösand AA and Mårtsbo AA, see Figure 39) points it was sort of good weather.

Figure 39: *The last A10 observation for RG 2000 has just been performed at Mårtsbo AA.*

6.2 A10-019

In 2008 DTU Space (Danish Technical University Space, Kongens Lyngby, Denmark) purchased the A10-019 gravimeter, mainly for observing in Greenland but also in Denmark. It has also been used to observe along the 56th degree land uplift gravity line. The following Subsection describes the only A10-019 campaign in Sweden so far.

6.2.1 The campaign in 2012

In April 2012, A10-019 observed along the 56th degree land uplift line, starting in Denmark and ending in Sweden. Unfortunately, it was not possible to observe the old points along the land uplift line in Höör and Sölvesborg with an A10, due to too small flat surfaces around the points. Therefore, new points were established at Höör church and Sölvesborg church (the step outside the western door was included in RG 62, but this had to be the step outside the southern door, since the RG 62 step was not suitable for A10) to be connected to the old points by relative gravimetry. A10-019 was operated by Jens Emil Nielsen (DTU Space) and the relative observations were performed by Andreas Engfeldt and Gabriel Strykowski (DTU Space). For the relative observations LCR G290 (which just came back from repair), Scintrex CG5-10740 (later in the report only called CG5-740) and two Danish Scintrex CG5s were used. The A10 observation in Höör AA was not satisfactory, so it was observed by Jens Emil Nielsen once more in June 2012 with a better result. The weather during the observations in April was sunny and not especially warm.

Figure 40: *The A10 observations at Sölvesborg AA (left) and digging up Höör B (right) during the 56th degree campaign in 2012.*

Unfortunately, LCR G290 behaved strangely from time to time, i.e. suddenly it made a jump of about 100 µGal both in Sölvesborg and in Höör. This meant that only about half of the observations with that instrument could be used. As it was proved by additional observations in Gävle that this instrument from time to time makes jumps of about 100 µGal, it became unfortunately useless for precise gravity observations.

6.3 A10 points

The following subsections contain a description of all points observed with A10. It is subdivided into an overview of already existing points from the old gravity networks and of newly established points.

6.3.1 Old RG 62 or RG 82 points

These points are the old RG 62 or RG 82 points which were possible to use for A10 observations and therefore were observed.

Arboga AA: The point was first used in the 1960s as an RG 62 point and is situated on a step outside the entrance of Heliga Trefaldighet church in the town Arboga. It is covered by a ceiling. The point is relatively connected to the A10 point Valla AA and the RG 82 First Order Network points Hallstahammar and Örebro.

Bjurholm AA: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock. The point is relatively connected to the RG 82 Zero Order Network point Lycksele A and the RG 82 First Order Network point Hällnäs.

Boda Bruk AA: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock (see Figure 49). The point is relatively connected to the FG5 points LMV AA and Mårtsbo AA, the A10 points Husby-Ärlinghundra AA and Sundsvall AA and the RG 82 First Order Network points Gnarp, Hybo and Vallvik.

Bollnäs AA: The point was first used in the 1960s as an RG 62 point and is situated on a step outside the entrance of Bollnäs church. The point is relatively connected to the FG5 point LMV AA, the A10 point Voxna AA, the RG 82 First Order Network points Arbrå and Vallvik and the RG 62 point Söderhamn 1p.

Duved AA: The point was first used in the 1960s as an RG 62 point and is situated on a step outside the entrance of Duved church. The point is relatively connected to the A10 point Stugun AA and the RG 82 First Order Network points Järpen and Ånn.

Eksjö AA: The point was first used in the 1960s as an RG 62 point and is situated on a step outside the entrance of Eksjö church. The point is relatively connected to the A10 points Gamleby AA and Västra Tollstad AA and the RG 82 First Order Network points Aneby, Lönneberga and Sävsjö.

Emmaboda AA: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock (see Figure 41). The point is relatively connected to the A10 points Köpingsvik AA and Ljungbyholm AA, the RG 82 First Order Network points Johannishus, Torsås and Urshult and the RG 62 point Algutsboda 1p.

Fredriksberg AA: The point was first used in 1990 as an RG 82 First Order Network point and is situated on bedrock. The point is relatively connected to the A10 points Grytnäs AA, Leksand AA, Ljusnarsberg AA and Vansbro AA, the RG 82 Zero Order Network point Karlstad NA and the RG 82 First Order Network point Ludvika.

Gällivare AA: The point was first used in the 1960s as an RG 62 point and is situated on a step outside the entrance of Gällivare church (see Figure 36). The point is relatively connected to the A10 point Kåbdalis AA, the RG 82 Zero Order Network point Jukkasjärvi NA and the RG 82 First Order Network points Gällivare, Hakkas and Jokkmokk.

Hammerdal AA: The point was first used in the 1960s as an RG 62 point and is situated on a step outside the entrance of Hammerdal church. It is covered by a ceiling. The point is relatively connected to the FG5 point Östersund AA, the A10 point Ragunda AA and the RG 82 First Order Network point Hallviken.

Hundsjön AA: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a large stone, some hundred meters from the small village Hundsjön, about 15 kilometres south west of the village Niemisel. The point is relatively connected to the A10 points Luleå and Övertorneå AA, the RG 82 Zero Order Network point Jävre NB and the RG 82 First Order Network points Bergnäset, Edefors and Kalix.

Hörnefors AA: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock. The point is relatively connected to the FG5 point Ratan AA, the A10 point Kramfors AB, the RG 82 First Order Network point Björna and the RG 62 point Hörnefors 1p.

Kramfors AB: The point was first used in 1972 in the 63rd degree land uplift gravity line and was then named Kramfors D and is situated on bedrock. In 1981 it became an RG 82 Zero Order Network main point. The point is relatively connected to the FG5 point Kramfors AA, the A10 points Härnösand AA, Hörnefors AA and Örnsköldsvik AA, the RG 82 Zero Order Network points Kramfors A, Kramfors B, Kramfors C and Stugun B and the RG 82 First Order Network points Gulsele, Sollefteå, Stavreviken and Åte.

Kåbdalis AA: The point was first used in 1981 as an RG 82 Zero Order Network main point and was then named Kåbdalis NA and is situated on bedrock (see Figure 36). The point is relatively connected to the A10 point Gällivare AA, the RG 82 Zero Order Network points Jukkasjärvi NA, Jävre NA, Jävre NB, Kvikkjokk NA, Kvikkjokk NB and Stensele A, the RG 82 First Order Network points Arvidsjaur and Jokkmokk and the RG 62 point Kåbdalis 1p.

Laxå AA: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock. The point is relatively connected to the A10 point Mariestad AA, the RG 82 Zero Order Network point Karlstad NA and the RG 82 First Order Network point Örebro.

Ljusfallshammar AA: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock. The point is relatively connected to the A10 point Västra Tollstad AA, the RG 82 First Order Network points Motala, Åtvidaberg and Örebro.

Ljusnarsberg AA: The point was first used in the 1960s as an RG 62 point and is situated on a step outside the entrance of Ljusnarsberg church in the village Kopparberg (see Figure 23). It is covered by a ceiling. The point is relatively connected to the A10 points Fredriksberg AA, Grytnäs AA and Säffle AA, the RG 82 First Order Network points Grythyttan and Lindesberg and the RG 62 point Ludvika 1p.

Luleå AA: The point was first used in the 1960s as an RG 62 point and is situated on a step outside the entrance of Luleå cathedral (see Figure 47). It is covered by a ceiling. The point is relatively connected to the A10 point Hundsjön AA and the RG 82 First Order Network point Bergnäset.

Mariestad AA: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock. The point is relatively connected to the A10 points Laxå AA and Vara AA and the RG 82 First Order Network point Dala.

Misterhult AA: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock (see Figure 34). The point is relatively connected to the A10 point Ljungbyholm AA, the RG 82 Zero Order Network point Västervik NA and the RG 82 First Order Network points Blomstermåla and Lönneberga.

Munkfors AA: The point was first used in 1990 as an RG 82 First Order Network point and is situated on bedrock. The point is relatively connected to the RG 82 Zero Order Network point Karlstad NA and the RG 82 First Order Network point Ekshärad.

Norrköping AA: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock. The point is relatively connected to the A10 points Nyköping AA and Valla AA, the RG 82 Zero Order Network point Ödeshög NA, the RG 82 First Order Network point Motala and the RG 62 point Skönberga 1p.

Nyköping AA: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock. The point is relatively connected to the A10 points Norrköping AA and Valla AA and the RG 82 Zero Order Network point Södertälje NA.

Ragunda AA: The point was first used in the 1960s as an RG 62 point and is situated on a step outside the entrance of Ragunda church. The point is relatively connected to the A10 points Hammerdal AA and Stugun AA and the RG 82 First Order Network point Sollefteå.

Simrishamn AA: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock (see Figure 33). The point is relatively connected to the A10 point Augerum AA, the RG 82 Zero Order Network point Höör B and the RG 82 First Order Network point Dalby.

Sollefteå AA: The point was first used in the 1960s as an RG 62 point and is situated on a step outside the entrance of Sollefteå church. The point is only relatively connected to the RG 82 First Order Network point Sollefteå.

Stugun AA: The point was first used in the 1960s as an RG 62 point and is situated on a step outside the entrance of Stugun church. The point is relatively connected to the A10 points Duved AA and Ragunda AA and the RG 82 Zero Order Network point Stugun A.

Stöllet AA: The point was first used in 1996 as an RG 82 First Order Network point and is situated on bedrock. The point is relatively connected to the A10 points Fryksände AA and Vansbro AA, the RG 82 Zero Order Network point Karlstad NA, the RG 82 First Order Network points Malung and Sysslebäck and the RG 62 point Norra Ny 1p.

Sved AA: The point was first used in 1992 as an RG 82 First Order Network point and is situated on bedrock some kilometres north of some houses called Sved. The point is relatively connected to the RG 82 Zero Order Network point Föllinge A, the RG 82 First Order Network points Gäddede and Stekenjokk and the RG 62 point Ström 1p.

Svenstavik AA: The point was first used in 2001 as an RG 82 First Order Network point and is situated on bedrock. The point is relatively connected to the A10 points Östersund AB and Överturingen AA, the RG 82 Zero Order Network point Stugun A and the RG 82 First Order Network points Rätansbyn.

Säffle AA: The point was first used in 1990 as an RG 82 First Order Network point and is situated on bedrock (see Figure 24 and Figure 30). The point is relatively connected to the A10 points Klöveskog AA, Ljusnarsberg AA and Årjäng AA, the RG 82 Zero Order Network point Karlstad NA and the RG 82 First Order Network points Dals Ed and Torsby.

Sävar AA: The point was first used in 1975 in the 65th degree land uplift gravity line and was then named Sävar A and is situated on bedrock. In 1981 it became an RG 82 First Order Network main point. The point is relatively connected to the FG5 points Ratan AA and Skellefteå AA, the A10 point Kramfors AB, the RG 82 Zero Order Network points Jävre NA and Lycksele A and the new point Ratan B.

Ulricehamn AA: The point was first used in the 1960s as an RG 62 point and is situated on a step outside the entrance of Ulricehamn church. The point is relatively connected to the FG5 point Borås AA, the A10 points Grinneröd AA and Öjaby AA and the RG 82 First Order Network point Bottnaryd.

Umbukta AA: The point was first used in the 1960s as an RG 62 point as one of very few RG 62 points situated on bedrock (see Figure 32). The benchmark is situated on the same piece of bedrock very close to two other benchmarks, just about 100 metres from the Norwegian border. The point is relatively connected to the A10 point Klimpfjäll AA, the RG 82 Zero Order Network point Umbukta A and the RG 82 First Order Network points Hemavan and Tärnaby.

Valla AA: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock (see Figure 30). The point is relatively connected to the A10 points Arboga AA, Norrköping AA and Nyköping AA, the RG 82 Zero Order Network point Södertälje NA and the RG 82 First Order Network point Eskilstuna.

Vansbro AA: The point was first used in 1996 as an RG 82 First Order Network point and is situated on bedrock. The point is relatively connected to the A10 points Fredriksberg AA, Leksand AA, Stöllet AA and Transtrand AA, the RG 82 Zero Order Network point Älvdalen A and the RG 82 First Order Network points Malung

Vara AA: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock. The point is relatively connected to the A10 points Mariestad AA and Tanum AA and the RG 82 First Order Network point Bottnaryd.

Årjäng AA: The point was first used in 1990 as an RG 82 First Order Network point and is situated on bedrock. The point is relatively connected to the A10 points Karlstad AA and Säffle AA and the RG 82 First Order Network points Arvika and Dals Ed.

Älvdalen AA: The point was first used in the 1960s as an RG 62 point and is situated on a step outside the entrance of Älvdalen church. When placing a gravimeter on the point, it is partly covered by a ceiling. The point is relatively connected to the A10 point Transtrand AA and the RG 82 Zero Order Network point Älvdalen A.

Östersund AB: The point was first used in the 1960s as an RG 62 point and is situated on a step outside the entrance of Östersund new church (see Figure 56). It is covered by a ceiling. The point is relatively connected to the FG5 point

Östersund AA, the A10 point Svenstavik AA and the RG 82 Zero Order Network point Stugun B.

Övertorneå AA: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a large stone. The point is relatively connected to the A10 points Haparanda AA and Hunsjön AA, the RG 82 Zero Order Network point Pello NA, the RG 82 First Order Network points Haparanda, Korpilombolo and Lansån and the RG 62 point Övertorneå 1p.

6.3.2 New points

From the very start, the thought was that so many RG 82 Zero Order Network points as possible should be observed with A10. The rest should be replaced by another point not so far away in g-value and in distance. In addition, many more other new points were established especially for the A10 observations, to make the distance between the A10 points something like 50-70 kilometres. The following points were established especially for the A10 observations.

Arjeplog AB: This benchmark for heights was reconnoitered during the FG5 observations in Arjeplog AA in 2011. This point is situated in a forest in the eastern part of the village Arjeplog, unlike Arjeplog AA which is situated about 40 kilometres north of it. The RG 82 First Order Network point Arjeplog, situated a couple of kilometres to the west, was not suitable for A10 observations, but is relatively connected to Arjeplog AB. The point is also relatively connected to the RG 82 First Order Network point Jäkkvik.

Arvidsjaur AA: The RG 82 First Order Network point Arvidsjaur should have been actually observed, but when arriving with the A10 we found that the point had been run over by a vehicle (probably the snow plough) and parts of the benchmark was destroyed. The RG 62 point in Arvidsjaur, Arvidsjaur 1p, was also not suitable for an A10. Hence, we determined another point, in the bottom of a concrete floor on the side of the church in Arvidsjaur, covered by a ceiling (see Figure 35). Both the old points are connected to Arvidsjaur AA relatively. The point is also relatively connected to the RG 82 First Order Network point Malå and the A10 point Sorsele AA.

Augerum AA: A point for A10 was needed in the east part of Blekinge. It was known in advance that neither the RG 62 point Jämjö 1p nor the RG 82 First Order Network point Johannishus were suitable for an A10. This church was reconnoitered via photos on the internet and was the second choice in the area. It was eventually selected after finding that the first choice (Fridlevstad church) was not suitable. Both the points Jämjö 1p and Johannishus have been connected relatively to Augerum AA. When using a gravimeter at the point, it is partly covered by a ceiling. The point is also relatively connected to the RG 82 First Order Network point Simrishamn AA.

Baltak AA: When planning the last A10 campaign, we found a potential large gap of AG points in the RG 2000 system between Lake Vänern and Västra Tollstad AA on the east side of Lake Vättern, which meant that a point in the area of Tidaholm was needed. This church step in Baltak south of Tidaholm was reconnoitered via photos on the internet and the first choice in the area. When using a gravimeter at the point, it is partly covered by a ceiling. The point is relatively connected to the RG 82 First Order Network points Dala and Bottnaryd and the A10 point Falkenberg AA.

Borgsjö AA: When planning the last A10 campaign, we found a potential large gap in the western part of Medelpad. This church step in Borgsjö was reconnoitered via photos on the internet and the first choice in the area. The point is relatively connected only to the RG 82 First Order Network point Torpshammar.

Bureå AA: We intended to observe the RG 62 point Bureå 1p, a church step outside the west entrance, but a step outside the main (north) entrance was better so it was chosen. However, in June 2019, the difference between the old (Bureå 1p) and this new (Bureå AA) point was observed relatively. The point is also relatively connected to the FG5 point Skellefteå AA and the RG 82 First Order Network points Burträsk and Lövånger.

Falkenberg AA: When planning the last A10 campaign, we found that another AG point was needed between Onsala AA and Veinge AA. Falkenberg was selected as the best suitable location. Falkenberg church was reconnoitered via photos on the internet and the first choice in the area. The church step is covered by a ceiling. The point is relatively connected to the RG 82 First Order Network points Torup, Veddige and Åseda and the A10 point Baltak AA.

Fryksände AA: The RG 82 First Order Network point Torsby was reported missing due to roadwork already a few years after it was observed in the early 1990s. Just a few meters from that point is another height fix situated. Before the reconnoitering, there was a hope that the other fix could be suitable for the A10, but it was not. Instead, one of the steps of the large church Fryksände was found suitable for the A10 during the stay in Torsby. The point is covered by a ceiling. The point is relatively connected to the RG 82 First Order Network points Ekshärad and Stöllet AA.

Gamleby AA: This point, at a step outside the back entrance of Gamleby church, was meant to become the A10 point close to the RG 82 Zero Order Network point Västervik NA and was reconnoitered on the way back from the 56th degree land uplift gravity line campaign in 2012. The difference between Gamleby AA and Västervik NA has been observed relatively and Gamleby AA is also relatively connected to the RG 82 First Order Network point Åtvidaberg.

Grinneröd AA: This point was the fourth church we reconnoitered during the day in the campaign in 2012. All churches had been checked on the internet in advance, but the photos' quality did not allow to say whether any of the church steps was good enough for the A10. This church had the only suitable step and it is covered by a ceiling (see Figure 48). The point is relatively connected to the A10 point Ulricehamn AA and the RG 82 Zero Order Network point Göteborg NB.

Grytnäs AA: In connection to another journey, this church was reconnoitered since we lacked an A10 point in the area and the surface of the RG 82 First Order Network point Avesta was unsuitable due to its tilt. These two points are now connected relatively during two occasions. The point is also relatively connected to the FG5 point LMV AA, the RG 82 Zero Order Network point Hofors B, the

RG 82 First Order Network points Fredriksberg AA and Tärnsjö, the RG 62 point Ljusnarsberg AA and the A10 point Leksand AA.

Haparanda AA: During the reconnoitering it was found that Haparanda 2 1p was situated on a wooden step and that Haparanda church did not have suitable steps (Haparanda 1 1p was since long ago destroyed). The RG 62 point at a stone step at the church in Karungi was considered but not good enough for A10. It was also known that the surface of the RG 82 First Order Network point Haparanda was too small for A10. When planning the last A10 campaign a point in Haparanda was remembered, included in the project RIX 95, where the author had measured with GNSS in 2008. The point was found suitable for A10 (see Figure 38) after it had been excavated under about 1 decimeter of sand. Haparanda AA and Haparanda are now connected relatively, while none of the RG 62 points are not connected to any of the other points (after Lennart Pettersson connected them to each other in 1973). The point is also relatively connected to the RG 82 First Order Network points Kalix and Övertorneå AA.

Hede AA: The intention was to use a step outside of Hede church, but they were all too poor to use for A10. Instead the large piece of bedrock in the ground level one meter from the main door of the church was used (see Figure 47). The RG 62 point Hede 1p, should be close to another door of the church, but it was not found during the reconnoitering and not checked afterwards. Therefore, the difference between the old and the new point has never been observed relatively. There is also an RG 82 First Order Network point, Hede, situated some 5 kilometres east of Hede AA and those are relatively connected at two different occasions. The point is also relatively connected to the RG 82 First Order Network points Sveg and Tännäs, the A10 points Sveg AA and the SGU point Överturingen AA.

Helsingborg AA: Before this point was chosen, the RG 62 point Saxtorp 1p was checked once more. In the reconnoitering it was marked as a perhaps possible point to observe with the A10, but it was this time found not good enough. Helsingborg AA was reconnoitered in photos on the internet and partly chosen by the name of the church – Andreas church – and proved to be excellent for the A10. The old RG 62 points in Helsingborg were never considered, due to bad surfaces and poor accessibility. The point is relatively connected to the RG 82 First Order Network points Åstorp and Dalby and the A10 points Maglarp AA and Veinge AA.

Husby-Ärlinghundra AA: This point was reconnoitered on the way back from the 56th degree land uplift gravity campaign in 2012. Since the A10 observation it has been used as the south point in our calibration line (see Figure 49), where LMV AA serves since 2014 as the north point instead of the A10 point Boda Bruk AA. This point is therefore relatively connected to these two points. The point is also relatively connected to the A10 points Norrtälje AA and Svinnegarn AA and the RG 82 First Order Network point Uppsala.

Härnösand AA: For the FAMOS project (see Subsection 7.2.2), a good gravity point was needed in Härnösand. The cathedral has a very large step and that one was chosen after seeing photos on the internet. The point is relatively connected only to the A10 point Kramfors AB.

Höör AA: During the reconnoitering the church in Höör was checked and it was found that the church step would be a good point for the A10 and become the A10 point close to the RG 82 Zero Order Network point Höör B. During the campaign Höör AA was observed with the A10, it was also connected to Höör B relatively by four gravimeters.

Junsele AA: When planning the last A10 campaign, we found that there was a large gap in the western parts of Ångermanland. This church step was reconnoitered via photos on the internet and the only choice in the area. The point is relatively connected to the RG 82 First Order Network points Gulsele and Stavreviken.

Karesuando AA: During the reconnoitering when looking for a replacement of Karesuando 1p (destroyed) it was found that the church step in Karesuando would be a good A10 point. The point is covered by a ceiling (see Figure 35). Four years after the A10 observations there, it was found in an old protocol book from Lennart Pettersson that he used the same point in 1973. The RG 82 First Order Network point Karesuando, situated some 3-4 kilometres south, was found not good enough for the A10, but is relatively connected to Karesuando AA. The point is also relatively connected to the A10 point Tärendö AA and the RG 62 point Pajala 1p. It is our northernmost RG 2000 point and the one with the highest gravity value in the main adjustment (see Chapter 9).

Karlstad AA: During the reconnoitering it was found that Karlstad NA was not suitable for the A10. The spare point Karlstad NB was reported lost in the 1990s by Lars Åke Haller, but a benchmark in bedrock was found some 10 metres away from the former Karlstad NB location. This new point was excellent for the A10 and became Karlstad AA. Karlstad AA is now relatively connected to Karlstad NA and to the RG 82 First Order Network points Arvika and Årjäng AA.

Klimpfjäll AA: In this area there are no churches and this point was the only possible height benchmark in the area, which luckily fulfilled all demands for A10 (see Figure 32). Klimpfjäll AA and the RG 82 First Order Network point Saxnäs are relatively connected at three different occasions. The point is also relatively connected to the RG 82 First Order Network point Stekenjokk and the RG 62 point Umbukta AA.

Klöveskog AA: When planning the last A10 campaign, we found that another point was needed in the south part of the western side of Lake Vänern, at best around Mellerud. This church step in Klöveskog southeast of Mellerud was reconnoitered via photos on the internet and the first choice in the area. The point is covered by a ceiling. The point is relatively connected to the A10 point Säffle AA and the RG 82 First Order Network points Dals-Ed and Uddevalla.

Kärda AA: This point was reconnoitered on the way to the 56th degree land uplift gravity campaign in 2012. No other existing gravity point in the area was suitable for the A10. When using a gravimeter at the point, it is partly covered by a ceiling. The point is relatively connected to the A10 points Ulricehamn AA and Öjaby AA and the RG 82 First Order Network points Lagan, Hillerstorp, Svenljunga and Torup.

Köpingsvik AA: This church was reconnoitered via photos on the internet and the third and eventually only possible one we checked in the area. The point is relatively connected to the A10 points Emmaboda AA and Ljungbyholm AA and the RG 82 First Order Network points Borgholm and Kastlösa.

Leksand AA: During the reconnoitering when looking for the RG 62 point Leksand 1p, several church steps in Leksand were found suitable for the A10. The one which seemed the best was chosen as Leksand AA in 2013 (see Figure 43). The point is relatively connected to the FG5 point LMV AA, the A10 points Fredriksberg AA, Grytnäs AA and Vansbro AA and the RG 82 First Order Network point Borlänge. As the RG 62 point is a less suitable point it has so far not been relatively connected to Leksand AA.

Ljungbyholm AA: This church step was reconnoitered via photos on the internet and was the first choice in the area. When using a gravimeter at the point, it is partly covered by a ceiling. The point is relatively connected to the A10 points Emmaboda AA, Köpingsvik AA and Misterhult AA, the RG 82 First Order Network points Borgholm and Blomstermåla and the RG 62 point Dörby 1p.

Ljusdal AA: This point was reconnoitered during my way home from a vacation in February 2013. The point is relatively connected to the A10 point Sveg AA and the RG 82 First Order Network points Hybo and Laforsen.

Maglarp AA: This point is situated on the concrete foundation of a church ruin (probably the only one of its kind in Sweden, see Figure 33). The point was found by the former colleague of the author in SKMF (Swedish Mapping and Surveying Association) Mats Elfström in 2011. The author reconnoitered it in connection to the 56th degree land uplift gravity line campaign in 2012 and it was found out to be excellent for the A10. It is the southernmost RG 2000 point and the one with the lowest gravity value. The point is relatively connected to the A10 point Helsingborg AA and the RG 82 First Order Network point Dalby.

Norrtälje AA: When planning the last A10 campaign, it was found that a point in the Norrtälje area was needed. The surface around the RG 82 First Order Network point Norrtälje was not large enough for an A10. Based on sketches four height benchmarks seemed suitable. The third we checked was excellent for the purpose and chosen. Norrtälje AA is now connected relatively to the point Norrtälje. The point is also relatively connected to the A10 point Husby-Ärlinghundra AA and the RG 82 Zero Order Network point Östhammar A.

Norsjö AA: During the reconnoitering when looking for Norsjö 1p (destroyed) it was found that the church step in Norsjö would be a good A10 point. The point is covered by a ceiling. It was some years later found that a point at another church step was observed by Lennart Pettersson in 1973 (see Subsection 7.2.1). The RG 82 First Order Network point in Norsjö had a too small surface to be observed with the A10, but it has been connected to Norsjö AA relatively. The point is also relatively connected to the A10 point Arvidsjaur AA and the RG 82 First Order Network point Malå.

Rimforsa AA: When planning the last A10 campaign, a large gap between the AG points in the south of Östergötland was found and a new point somewhere around the village Rimforsa would be needed. Two height benchmarks seemed suitable based on sketches. One of them was excellent for the purpose and chosen (see Figure 37). The point is relatively connected to the A10 point Solna AA and the RG 82 First Order Network points Kisa (twice) and Åtvidaberg.

Solna AA: When planning the last A10 campaign, a point close to Stockholm on the north side of the city was needed as Tullinge AA is close enough, but on the south side. Therefore, we chose Solna AA (see Figure 37), on a walking distance from the RG 82 First Order Network point Solna. These two points are now connected relatively. The point is also relatively connected to the A10 point Rimforsa AA.

Sorsele AA: The Sorsele area was visited in late 2011 when going home from FG5 observations in Arjeplog. The RG 82 First Order Network point Sorsele as well as three height fixes in the area were not suitable for an A10. Instead, the church step was chosen. The point is relatively connected to the A10 points Arvidsjaur AA and Norsjö AA and the RG 82 Zero Order Network point Stensele B.

Stensele AA: This point was meant to become the A10 point close to the RG 82 Zero Order Network point Stensele B (and Stensele A, some 10 kilometres further away) and was found during reconnoitering the RG 62 point Stensele A 1p. The RG 62 point is very unsuitable, since it is situated on the lid of a well. In the 1970s a new point, called Stensele B 1p (or Stensele step 1p), was observed at the bottom step of the main (west) entrance of Stensele church. This step is both small and unstable, why the much better step outside the south entrance was chosen (see Figure 38). Stensele AA and Stensele B are now relatively connected, but none of the RG 62 points are connected to Stensele AA. The point is instead also relatively connected to the A10 point Vilhelmina AA and the RG 82 First Order Network point Strömsund.

Sundsvall AA: The intention was to observe Sundsvall 1p (in the recess on the left side of the door), but the stone was flawed. However, the stone’s quality was better in the recess on the right side of the door (see Figure 31), so this point was chosen as Sundsvall AA to replace Sundsvall 1p. These two points are now relatively connected. The point is also relatively connected to the A10 point Boda Bruk AA and the RG 82 First Order Network points Stavreviken and Torpshammar.

Sveg AA: This point was reconnoitered during my way home from a vacation in February 2013. The RG 82 First Order Network point Sveg was not possible to observe with the A10, but it is relatively connected to Sveg AA at two different occasions. The point is also relatively connected to the A10 points Hede AA, Ljusdal AA, Särna AA and Voxna AA and the RG 82 First Order Network points Hede and Lofsdalen.

Svinnegarn AA: The church was reconnoitered via photos on the internet and proved to be very good for the A10 (see Figure 34). The RG 82 First Order Network point Enköping was omitted due to a bad surface. The point is relatively connected to the FG5 point LMV AA, the A10 point Husby-Ärlinghundra AA and the RG 82 First Order Network points Hallstahammar and Uppsala.

Särna AA: It was intended to observe the RG 62 point Särna 1p, on the step to the new church, but the stone was flawed and not at all suitable for the A10. Instead, the stone slab of the the old church, situated about 200 meters east of the new church, was excellent for the A10. Särna AA and Särna 1p are now connected relatively. The point is also relatively connected to the A10 points Transtrand AA and Sveg AA, the RG 82 First Order Network point Idre and the RG 62 point Malung 1p.

Sölvesborg AA During the reconnoitering when looking for Sölvesborg 1p, it was found that this church step was much better to use for an A10 and that it should become the A10 point close to the RG 82 Zero Order Network point Sölvesborg A. During the campaign Sölvesborg AA was observed with the A10 (see Figure 40), it was also connected to Sölvesborg A relatively by four gravimeters.

Tanum AA: The intention was to observe Tanum 1p, but the stone on the north entrance was flawed and thus we switched to the east entrance of the church. Unfortunately, the difference between the old and the new point has so far not been observed relatively. The RG 82 First Order Network point Tanum could not be found in 2011 and 2012, so this point is also not connected yet. The point is instead relatively connected to the A10 point Vara AA and the RG 82 First Order Network point Dals-Ed.

Transtrand AA: This point was meant to replace both the RG 82 First Order Network point Transtrand and the RG 62 point Transtrand 1p and was found during the reconnoitering in 2011 (see Figure 44). The difference between Transtrand AA and Transtrand has been observed at two different occasions, but the RG 62 point has so far not been relatively connected. The point is also relatively connected to the A10 points Särna AA, Vansbro AA and Älvdalen AA.

Tullinge AA: This church is situated at a calm place in the village where the author grew up. During the reconnoitering it was found that the RG 62 point Turinge 1p, which was intended to become the A10 point close to the RG 82 Zero Order Network point Södertälje NA, also was not suitable for the A10. Instead, the church step in Tullinge became that point as it has the advantage of being close to Stockholm and thus can be used for all gravity work on the southern side of Stockholm city (see Figure 45). Tullinge AA is now connected to Södertälje NA relatively. The point is also relatively connected to the RG 82 First Order Network point Jordbro.

Veinge AA: This point was meant to replace the RG 82 First Order Network point Laholm (which was not found during the reconnoitering, but some years later) and the destroyed RG 62 point Veinge 1p and was found during the reconnoitering in 2011. The difference between Veinge AA and Laholm has been observed at two different occasions. The point is also relatively connected to the A10 points Helsingborg AA and Älmhult AA, the RG 82 First Order Network point Sävsjö and the RG 62 point Varberg 1p.

Virserum AA: When planning the last A10 campaign, a large gap of AG points in the north of Småland needed to be filled with a new point between the villages Åseda and Virserum. The old RG 82 point Åseda was not large and flat enough for the A10, so four height benchmarks which seemed very good on sketches were checked. One of them was excellent for the purpose and chosen. Virserum AA is now connected to Åseda relatively. The point is also relatively connected to the A10 points Rimforsa AA and Öjaby AA and the RG 82 First Order Network point Lönneberga.

Voxna AA: A new A10 point was needed in the area and before the last A10 campaign started, two height benchmarks and two churches were checked with sketches or the internet. The step of the first church, Ore, was too exposed to the wind and not chosen since it was extremely windy during the campaign. The two height benchmarks were also unsuitable for A10 observations. The last church, Voxna, has a wooden step (which could not be seen on internet photos), but there was a large stone in the wall on the south side of the church with an old benchmark where we could put the A10 (see Figure 44). Later, the A10 observation turned out to be very bad (see Subsection 6.1.5) with a large gross error. This observation was therefore removed in the adjustment. The point is relatively connected to the A10 points Bollnäs AA and Sveg AA and the RG 82 First Order Network point Voxna.

Västra Tollstad AA: This point was one of the four points reconnoitered in connection to the 56th degree land uplift gravity line campaign in 2012 and the first choice to become the A10 point close to the RG 82 Zero Order Network point Ödeshög NA. These two points are now relatively connected. The point is also relatively connected to the A10 points Eksjö AA and Ljusfallshammar AA.

Åsele AA: This church step was found during the reconnoitering in 2011. Some kilometres from Åsele is the RG 82 First Order Network point with the same name as the village, but that point was not appropriate to use neither for A10 nor for relative instruments, due to among others an extremely big bush growing over the big stone where the benchmark is situated. Therefore these points are not relatively connected. The point is instead relatively connected to the A10 point Vilhelmina AA and the RG 82 First Order Network points Gulsele and Saxnäs.

Älmhult AA: The intention was to use the RG 62 point Stenbrohult 1p. Administrative issues hampered a measurement there and thus the next possible church, Älmhult, was chosen. The difference between Älmhult AA and Stenbrohult 1p has been observed relatively. The point is also relatively connected to the A10 point Veinge AA and the RG 82 First Order Network point Osby.

Älvsbyn AA: When planning the last A10 campaign, it was found that a new A10 point in the Älvsbyn area was needed. The area around the RG 82 First Order Network point Älvsbyn was not large enough for an A10, but four height benchmarks seemed suitable based on sketches. The first we checked was very good for the purpose and chosen. These two points are now relatively connected. Älvsbyn AA is also connected to the RG 82 First Order Network point Bergnäset.

Öjaby AA: This church step was reconnoitered via photos on the internet and was the first choice in the area. The point is relatively connected to the A10 points Kärda AA and Virserum AA and the RG 82 First Order Network points Lagan and Ör.

Öregrund AA: This was the first choice out of four height benchmarks to become the A10 point close to the RG 82 Zero Order point Östhammar A. The gravity difference between Öregrund AA and Östhammar A has been observed at three different occasions.

Örnsköldsvik AA: The sketch of Örnsköldsvik 1p in *Pettersson (1967)* was better than most other sketches of the RG 62 points. However, the point was placed unsuitably for our purposes on the church step, thus it was decided already during the reconnoitering that it should be moved about 3 metres (see Figure 31). The difference between the RG 62 point and this new point was first observed in June 2019, therefore Örnsköldsvik 1p was not included in the first realization of RG 2000. The point is also relatively connected to the A10 point Kramfors AB.

6.4 Chosen observations

For the first realization, all A10 observations were chosen except the following: Those with gross errors (Voxna AA and the second observation in Transtrand AA), and the ones at the check points (Mårtsbo AA, Kiruna AA and Onsala AA). For the second realization additionally the observation in Holmsund AA was removed due to the gross error which was found in 2019.

As mentioned in 6.1.1, at least one point already observed with FG5 was observed during every campaign, where it was used as a reference value to check that the A10 results were reliable over time. The check of these points showed a standard deviation of 3.9 µGal from the later adjusted g-value at the epoch 2000.0.

7 Relative observations

During the work with the adjustment it became obvious that the observations from the campaign in 1973 (see Subsection 7.2.1), when Lennart Pettersson re-visited many of the RG 62 junction points with the (at that time) new LCR gravimeters, were not good enough to be used together with the better data observed later. Still, these data is interesting since it provides more connections between the RG 62 system and the RG 2000 system as well as better values for several RG 62 points. Therefore, it was decided to split the data and run two adjustment steps: First, a main adjustment with the better data, and then a second adjustment with the less good data. This approach allowed to keep the quality of the good data. Otherwise, if the less good observations would have been used in the main adjustment, the points with better values observed after 1973 would have been influenced by about 1 µGal, even if the weights for the 1973 observations would have been very low.

In the following Sections and Subsections, the different campaigns of relative observations are presented and so are the chosen observations both for the main adjustments and for the second step adjustments.

7.1 Observations in the main adjustment

The chosen observations in the main adjustment are divided into seven categories, based on when and for what purpose they were observed.

7.1.1 Observations from the RG 82 Zero Order campaign

The relative observations for the RG 82 Zero Order campaign took place during 1981 and 1982. In the adjustment which led to RG 82, all observations between points on the land uplift gravity lines were included as "precomputed differences" (see Subsection 7.1.5). This means that these differences were not observed in this campaign, but before. The level of the Zero Order Network was based on four absolute gravity observations (see Section 2.3), all observed by the Italian gravimeter IMGC. These absolute observations were not included here for natural reasons. The relative observations were performed by Lennart Pettersson in the northern half of Sweden and Lars Åke Haller in the southern half.

Most differences were observed twice like A-B, B-A, where A is the first point and B is the second point *(Engfeldt 2016a)*. The differences between Kåbdalis AA and Kvikkjokk NA, and between Jukkasjärvi NA and Kvikkjokk NA were only observed once. The differences between Mårtsbo AA and Östhammar A were observed several extra times due to not well-fitting observations. This difference was observed again in 2016, just as a check to the observations in 1981/82. All main points had one spare point each and two of the points along the 63rd land uplift gravity line had three spare points each (Kramfors and Stugun). The spare points on the land uplift gravity lines were observed before 1981 and most of the other spare points after 1983. All of them were used as precomputed differences in the first RG 2000 realization (see Subsections 7.1.9 and 7.1.10) and as normal observations in the second RG 2000 realization. The two instruments LCR G54 and LCR G290 were used parallel during the whole campaign.

The relative observations between the two absolute points situated abroad, and the closest point included in Sweden (Sodankylä – Pello NA and København Gamlehave – Höör A) could not been found anywhere. Therefore, these two absolute points got no g-value in RG 2000. Sodankylä has a good time series of absolute gravity and could have been included if the relative observations had been found. København Gamlehave, in turn, has no good absolute gravity series and was destroyed long ago.

7.1.2 Observations from the RG 82 First Order campaign

The First Order Network is not a network in any real meaning, since only 15 points are connected from more than one starting point *(Engfeldt 2016a)*. The main reason for that was that the calculation software used for the RG 82 First Order points could not handle loops of points starting and ending on different points. However, it is still a densification of the Zero Order Network and consists of 149 points. Its main purpose was to get a point in every "Storruta", a map index used at the time, whereas every "Storruta" was a square of 50x50 kilometres.

The campaign got low priority during the 1980s and 1990s when Lars Åke Haller did the observations. In 1984, Gotland was densified. In 1985, the area between Göteborg and Karlstad west of Lake Vänern was densified. In 1990, parts of Värmland and the area between Karlstad and Stockholm was densified. In 1992, the very southern part of Lappland and the north part of Jämtland was densified. In 1996, the remaining part of Värmland and the southwest part of Dalarna was densified. Totally 41 new points were established during these years. Due to a Nordic geoid project (which resulted in the geoid NKG 2004), the campaign was given high priority in 2001 and 2002. In 2001, Andreas Engfeldt did the observations. Then the rest of Dalarna, Härjedalen, Jämtland and almost all of Lappland was observed, resulting in 34 new points. In 2002, Andreas Engfeldt continued to observe 43 new points and Håkan Skatt observed 31 new points. After that, Sweden was covered according to the plan and the campaign was finished *(Engfeldt 2016a)*.

Figure 41: *Observations for the RG 82 First Order Network, at Lofsdalen (left, in 2001) and at Emmaboda AA (right, in 2002).*

All observations from the campaign were included from the start, but during the work with the adjustment some observations which proved to be outliers were removed. An outlier here means an observation where the Gad software points to a sigma value >3 (see 8.3.4).

In the adjustment, we first used the same scale factor for the respective instrument during the whole observation period. When testing to split these up into one for the Zero Order campaign, one for the First Order campaign 1984-96 and one for the First Order campaign 2001-02 (and further on to 2004), the results looked more consistent and better. Still, in the second realization of RG 2000, when using some more data than in the first realization, the scale factors got better when using only one factor per instrument for the years 1984-2004.

7.1.3 Observations from the RG 2000 campaign

The RG 2000 campaign started on June 15, 2015, when the LCR gravimeter G54 had come back from cleaning and service. The first observations were between the RG 62 point Skutskär 1p and Mårtsbo AA forward and back. During the first month, G54 had a much larger drift than before and after, but this was accounted for in the software. The other used instrument was Scintrex CG5-1184, which most of the time worked very well. An exception was the last two days in August 2016 during observations in Småland when it behaved strangely from time to time.

In 2015, the focus was to make connections between the new points observed with A10 in 2011-15 and either FG5 points (not so common) or RG 82 points. The reason for that was to turn the new points into multiple-connection points, so that they could be checked for gross errors (not that the RG 82 points were free from errors, but still it was a valuable check). A smaller, but not insignificant focus was to tie a few good (concerning the physical quality of the point) RG 62 points to the network. The purpose was to get a better transformation connection and a good g-value in RG 2000 for the point in question.

Figure 42: *RG 2000 observations in 2015, at Skutskär 1p with LCR G54 (left) and at Stensele B with CG5-1184 (right).*

In 2016, the focus changed to strengthen the network. That was done in a few separate ways, like connecting RG 82 points where the quality of the previous observations was of unknown or less good quality or to tie together the new points observed with A10 to more RG 82 points.

Figure 43: *Observations for RG 2000 in 2016, at Hoting with LCR G54 (left) and at Leksand AA with CG5-1184 (right).*

In 2017, the focus was to make more connections where the network seemed incomplete and to check two possible gross errors in the A10 observations. The new observations for the latter were a success and it was found that Voxna AA had a gross error of ca. 70 µGal and that the second A10 observation in Transtrand AA had a gross error of ca. 30 µGal.

Figure 44: *RG 2000 observations in 2017, at Transtrand AA with LCR G54 (left) and at Voxna AA with CG5-1184 (right).*

The RG 2000 campaign ended on October 26, 2017 at Tullinge AA (see Figure 45). This date was chosen as a tribute to Lars Åke Haller who would have celebrated his 79th birthday that day.

Figure 45: *The last observation for the RG 2000 campaign in 2017 has just been performed at Tullinge AA.*

All observations in this category were performed by Andreas Engfeldt, except some observations in 2017 between Mårtsbo AA, Uppsala and Uppsala C 1p originally for the print *Ekman, Olsson (2017)* performed by Per-Anders Olsson.

7.1.4 Additional observations 2003-14

The observations in 2004 were performed in order to get connections between RG 82 and the quite recently established absolute gravity points Visby AA, Östersund AA and Arjeplog AA. The points established in the 1990s, Kiruna AA and Skellefteå AA, were also connected to RG 82 in 2004. Much later, it turned out that Lars Åke Haller had already connected these two points to RG 82 earlier.

Figure 46: *Relative observations in 2004 at Visby NA with G54 in connection to the FG5-220 observations at Visby AA.*

Kramfors AA was first connected to RG 82 and Kramfors AB in 2003 in connection to the last campaign along the 63rd degree land uplift gravity line, but was connected again with the Scintex CG5-10198 (later in the report only called CG5-198) in 2008, which was purchased the previous year. During the same AG journey, a new point right outside of the hut of Östersund AA was established, called Östersund B, since the point Östersund at the time was occupied with FG5-233. The new point was used as a starting point of the small loop, Östersund B – Föllinge B – Krokom – Järpen – Östersund B, which was observed once just as a check of the performance of the CG5-198 instrument. When the FG5 observations were finished, the two points Östersund AA and D were connected to each other with CG5-198. Unfortunately, CG5-198 was not in its best state then, slowly degrading during 2008 and becoming totally unusable in 2009. However, the observations could still be used here.

In 2011, the starting points for the geoid measurements at Lake Vänern were connected to three RG 82 points. Mariestad AA and Vara AA were then connected to each other with the best instruments at the time, CG5-740 and G54.

In connection to the first four A10 campaigns (2011-2013) with the Polish A10-020, gradient measurements have been performed at the points observed with the

A10. These measurements were performed with the best Scintrex at the time, CG5-740. The averages of the observations on the ground have been used to get connections between the points which were observed during the same day. These kinds of observations are considered as less accurate than observations especially dedicated to the purpose, so it has been considered in the setting of weights.

Figure 47: *Gradient measurements with Scintrex CG5-740 at Hede AA in 2012 (left) and at Luleå AA in 2013 (right).*

In spring 2012, G290 came back from its second repair (as it was found broken again half a year after the first repair in 2005) and it was tested in Mårtsbo, connecting Mårtsbo B to Mårtsbo AB, which was also performed with the Scintrex CG5-740. Unfortunately, only the observations with the Scintrex were later found good enough and are included here. Before being able to evaluate the Mårtsbo observations, the Danish A10-019 was on visit along the 56th degree land uplift gravity line (see Subsection 6.2.1). Two new A10 points were needed to replace the two existing Swedish points on this line. In connection to the A10 observations, the new points Höör AA and Sölvesborg AA were connected to RG 82 and the land uplift line via observations with three Scintrexs and G290. Here there was a jump for G290 both in Höör and in Sölvesborg. Hence, 50% of the observations of G290 could be used and are included as precomputed differences together with the observations from two Danish Scintrexs.

In 2013, some pre-observations for RG 2000 were performed in connection to AG observations in Borås and Onsala. The two at the time best gravimeters were used, which means LCR G54 (even if it was very dark on the inside and very hard to read, which led to that it was sent to the USA for cleaning the following year) and Scintrex CG5-740 (which was replaced by the later purchased Scintrex CG5-1184 in the RG 2000 campaign). The three points Borås AA, Borås and Borås 1p got connected to each other twice, as well as the points Onsala AA and Göteborg NB, Göteborg NB and Grinneröd AA (see Figure 48), Onsala AA and Veddige (see Figure 48), Veddige and Varberg 1p, Varberg 1p and Veinge AA, and Varberg 1p and Onsala AA. The observations at the point Borås did not really fit and the first observation in Onsala AA to Veddige with CG5-740 was somehow bad, but otherwise the observations were satisfactory. During AG observations at Borås AA the following year, the points Borås AA and Borås was connected again with CG5-

740 and also Borås AA and Ulricehamn AA was connected with the same gravimeter. At this time G54 was regarded as too dark to observe with.

Figure 48: *Observations in 2013, at Grinneröd AA with CG5-740 (left) and at Veddige with G54 (right).*

In November 2012 we started to use the points Husby-Ärlinghundra AA, LMV AA and Boda Bruk AA as a calibration line for the relative gravimeters (see Figure 49). From 2014, only LMV AA and Husby-Ärlinghundra AA has been used and either one or two times every year. Some of these observations are included here.

Figure 49: *Observations at the two original end points of the calibration line, Husby-Ärlinghundra AA with Scintrex CG5-1184 and with Scintrex CG5-740 standing on the left side waiting for its turn in 2019 (left) and Boda Bruk AA with LCR G54 in 2016 (right, even if this particular photo shows an observation for RG 2000).*

All observations in this category were performed by Andreas Engfeldt, except the observations in 2012 with two Danish Scintrex gravimeters performed by Gabriel Strykowski.

7.1.5 Land uplift observation campaigns 1975-2003

In 1967, the first observations on the 63rd gravity land uplift line took place in Sweden *(Engfeldt 2016a)*. Some years later, three more land uplift gravity lines were established. Here, all computed results between 1975 and 1983 with LCR G-meters published in *Mäkinen et al (1986)* have been used as "precomputed differences". The observations with the two Swedish instruments (G54 and G290) during 1987, 1993 and 2003 are also used as normal gravity observations, as well as the observations with the Norwegian instruments in 2003. The observations with the Finnish and Danish instruments in 2003 should have been included, but were unfortunately forgotten when preparing the data. However, the result would just have changed very little if they had been included. The Swedish observations in 1998 were regarded as bad already the year after they were observed, thus they are consequently not included. The rest of the observations from the land uplift lines were not available to us at the time. In order to avoid strange scale factors (a lot of data and a large gravity difference is needed for getting a good scale factor – here the points are designed so that the gravity difference should be within 1 mGal), we have decided to set the scale factor of all non-Swedish gravimeters to 1.000000.

The observations in this category were performed by many different people, among others Lennart Pettersson†, Lars Åke Haller†, Åge Midtsundstad†, Aimo Kiviniemi†, Ole Bedsted Andersen†, Bjørn Geirr Harsson, Jaakko Mäkinen, Andreas Engfeldt and Håkan Skatt.

7.1.6 Additional observations 1972-1979

For all points along the gravity land uplift lines, spare points were observed during 1972-79 and were connected by relative gravity observations to the main point. Several observations connecting RG 62 points to points along the gravity land uplift lines were also performed.

All observations in this category were performed by either Lennart Pettersson or Lars Åke Haller.

7.1.7 Observations from 2019

In the leave-one-out cross validation in the main RG 2000 adjustment in 2018, Holmsund AA turned out to be a point where the relative observations and the absolute observation fitted the least. Since this is an indoor point equipped with a concrete pillar, the author suggested to observe Holmsund AA with the FG5X directly connected to observations in Ratan AA, planned in June 2019. Holmsund AA was so far only observed with an A10 despite the point itself looks exactly like an FG5 point (see Section 3.4.14). Since there had been no official international comparisons after the last service of FG5X-233 in late 2018, the absolute level of the FG5X was unknown at the time. It was solved by using FG5X-233 as a very good and highly expensive relative gravimeter between Ratan AA and Holmsund AA.

In connection to the same FG5X campaign, which scheduled observations at Lycksele AA and Skellefteå AA, several relative observations were performed. One of them was performed in order to get a spare point outside of the hut where Lycksele AA is situated and one of them was performed in order to get a g-value of Lycksele C, which according to *Haller, Ekman (1988)* was observed in 1988 but whose result we had not found. The rest were performed either to get a better RG 2000 value of an RG 62 point or to strengthen the network in the Umeå area.

In connection to the FG5X campaign in Onsala in August 2019, two new points were observed: Onsala A outdoors in the Space Observatory area and Onsala B outside all gates and fences. Here, also the RG 62 point Härryda 1p was observed, but the instrument jumped almost 100 µGal before the arrival in Härryda. Since then, the instrument CG5-1184 has from time to time not worked as normal.

In early autumn 2019 it was decided that also the point Klimpfjäll AA, which was the second worse in the leave-one-out cross validation in 2018, should be observed again with relative instruments. The three Scintrexs CG5-198, CG5-1184 and CG5-740 as well as LCR G54 were used to observe the points Vilhelmina AA, Saxnäs, Klimpfjäll AA and Stekenjokk (the RG 82 point with the least number of observations) forward and later back in September 2019. CG5-198 and CG5-1184 performed well with one small exception each and these observations fitted very well too each other, while the other two instruments only partly performed well.

Figure 50: *Observations in 2019, at Stekenjokk with CG5-1184 (left) and at Ludvika with CG5-198 (right).*

The last relative journey was also performed in late September in one day, to connect the RG 82 First Order Network point Ludvika to the RG 62 point Ludvika 1p. The observations in 1990 at Ludvika were uneven and the point was not found in the reconnoitring 2011 but found and used by SGU in 2018. Ludvika 1p on the other hand was found in 2011 and connected relatively to Ljusnarsberg AA in 2017. All instruments except the least well-functioning CG5-740 were used and apart from a 20 µGal jump with CG5-198, they all performed well.

It should also be mentioned that the point LMV Pol 7 was established to ease the work of organizations like SGU. This point on a large stone outside of the Lantmäteriet headquarter in Gävle can be used without accessing the building. It was connected to LMV AA at three different occasions during 2019, twice with CG5-1184 and once with CG5-198.

All observations in this category were performed by Andreas Engfeldt.

7.1.8 Instruments used

The relative gravimeter which were used are the following: LCR G54 and G290, Scintrex CG5-198, CG5-740 and CG5-1184. Additionally, several other LCR instruments model G were used for the land uplift gravity line observations. In the software, the instruments only used for the land uplift gravity line observations were merged into one instrument, GNordic, with the known calibration factor 1.0. LCR G54 and G290 were instead divided into several instruments due to the time period they were used and that different scale factors were expected (see Subsection 9.2.). Table 4 shows what the instruments were called in the software.

Table 4: Gravimeters used for RG 2000. * For the first RG 2000 realization in 2018. ** For the second RG 2000 realization in 2019.

Instrument name	Time period	Name in the software
LCR G54	1975-1978	G544
LCR G54	1979-1982	G54
LCR G54	1984-1996*	G54L
LCR G54	2001-2014*	G54Y
LCR G54	1984-2014**	G54Y
LCR G54	2015-2019	G54X
LCR G290	1975-1978	G2900
LCR G290	1979-1982	G290
LCR G290	1984-1996*	G290L
LCR G290	2001-2003*	G290Y
LCR G290	1984-2003**	G290Y
Scintrex CG5-10198	2008	CG5-198
Scintrex CG5-10198	2019**	CG5-198X
Scintrex CG5-10740	2013-2019	CG5-740
Scintrex CG5-11184	2015-2019	CG5-1184
LCR G45, G55, G378 etc	1975-2003	GNordic

7.1.9 Chosen observations for the first RG 2000 realization (2018)

From start all the observations mentioned in Subsections 7.1.1 to 7.1.7 were included (see Figure 51) and so were also the observations in Subsections 7.2.1 and 7.2.3. During the adjustment, first the observations in Subsections 7.2.1 and 7.2.3 were removed. The relative observations in Subsections 7.1.1 to 7.1.6 which the software Gad pointed out as gross errors (sigma >3 µGal, ca. 100 observations) were also removed. 3721 relative observations and 171 precomputed differences were included in the final main adjustment in 2018.

The following observations were excluded: Three days in 1977 with G290 (which means 9 of 12 observations with that instrument that year), four days in 2001 with G290 (totally 20 observations, of which 16 observations belonged to the same line and when the instrument performed less well), one day with G54 in 2002 (5 observations, when the power supply cable got broken right after what should have been the second last observation) and both G54 and G290 during another day in 2002 (totally 8 observations). Apart from that, there are single observations, 1 with CG5-740 in 2012, 2 with G290 in 1981, 6 with G290 in 1985, 2 with G290 in 1990, 5 with G290 in 2001, 9 with G290 in 2002, 2 with G54 in 1985, 3 with G54 in 2002 (2 due to that the box of the instrument got hot during the lunch break), 3 with G54 in 2013, 11 at LMV AA in 2016-17 with G54, 6 other with G54 in 2016 (of which 1 was due to power loss of the instrument and 4 was a section where one of the two points was in a construction area). This means that 92/3813 relative observations were removed, which is about 2.4%.

MAIN ADJUSTMENT	
FG5 observations, one averaged per FG5 point	LCR observations, RG 82 Zero Order Network
A10 observations, one averaged per A10 point	LCR observations, RG 82 First Order Network
Precomputed differences, Land uplift gravity line observations	LCR & Scintrex observations, RG 2000 campaign
Precomputed differences, RG 82 Zero Order Network spare points	LCR & Scintrex observations, Additional observations

Figure 51: *Summary of the observations included in the Main Adjustment in 2018.*

7.1.10 Chosen observations for the new RG 2000 realization (2019)

The observations used in the RG 2000 realization in 2018 were used again (see Figure 52). In addition, most of the observations in Subsections 7.1.1 to 7.1.6 that were removed in the previous realization were added again. An exception are a few very obvious gross errors. For example, two days of observations in Subsection 7.1.5 with both G54 and G290 were removed. More about the difference between this realization and the previous realization can be read in Section 7.4.

MAIN ADJUSTMENT	
FG5 observations, one averaged per FG5 point	LCR observations, RG 82 Zero Order Network
A10 observations, one averaged per A10 point	LCR observations, RG 82 First Order Network
Precomputed differences, Land uplift gravity line observations	LCR & Scintrex observations, RG 2000 campaign + 2019
Precomputed differences, FG5 observations Ratan AA – Holmsund AA	LCR & Scintrex observations, Additional observations

Figure 52: *Summary of the observations included in the Main Adjustment in 2019.*

The following observations were excluded: Two days in 1977 with G290, one day with G54 in 2002 (when the power supply cable got broken right after what should have been the second last observation) and both G54 and G290 during one day of observations along the 63rd degree land uplift gravity line in both 1987 and 1993 (3 observations per instrument and day). Apart from that, there are single observations, 4 with CG5-740 in 2019, 3 with G290 in 1981, 3 with G290 in 1985, 5 with G290 in 2001, 1 with G290 in 2002, 3 with G54 in 1985, 1 with G54 in 2001, 3 with G54 in 2002 (2 due to that the box of the instrument got hot during the lunch break), 3 with G54 in 2013, 11 at LMV AA in 2016-17 with G54, 6 other with G54 in 2016 (see Subsection 7.1.9) and 4 with G54 in 2019. This means that 66/4190 relative observations were removed, which is about 1.6%.

7.2 Observations in the second step adjustment

All points from the main adjustment which are also included in the second step adjustment got the start g-value directly from the main adjustment. The á priori standard uncertainty of this g-value was set to 0.1 µGal. This very low uncertainty has successfully been used in order to keep the g-value in the second step.

7.2.1 Observations from the 1973 campaign

Very little is known about this campaign, except what can be read and, frankly, interpreted from the protocol books. The observations with the LCR G54 were by coincidence found in 2016 during search of a software for network adjustment. The data was on a server in a folder with the only remaining part of the old adjustment software, Grut, and it was not mentioned in any documents. The observations with the other instrument, LCR G290, could be found in the protocol books.

The campaign was performed by Lennart Pettersson and it lasted for 29 days, which means that it was a very long campaign. The campaign was divided into two parts, one journey to the south lasting 12 days and one journey to the north lasting 17 days, with only two days break in between. Both the journeys started and ended at RAK 04 (RAK = Rikets Allmänna Kartverk, which in 1974 was incorporated in Lantmäteriet) in Hässelby, where the office was at that time. Totally 37+45 points were observed, of which 72 points were RG 62 points (including most Swedish junction points, see Appendix 3) from Bulltofta 1p in the south to Karesuando 1p in the north, 4 points were points on the 63rd gravity land uplift line (established in 1967) and 6 points were new. Unfortunately, the point descriptions of the new points were not the best, making most of them unusable today. The new points were Sturup airport (without point description and most likely destroyed now), Tösse church (we know which step and the measure in eastern/western direction), Norrby church in Sala (without point description), Kårböle church (with a good point description), Norsjö church step (we know which step and the measure in eastern/western direction, it is at another step than the later established Norsjö AA) and Karesuando church (most likely at exactly the same place as Karesuando AA, which was established in 2013). The quality of the observations is very uneven, both between the instruments and between the two times they were observed with the same instrument. Therefore, these had to be removed from the main adjustment.

Still, it was decided to try these in the adjustment later, in order to get more connections between RG 62 and RG 2000 and in order to get better RG 2000 values on these RG 62 points. Even if the quality of the observations is uneven, they give us better values in RG 2000 than we would get if we just use the transformation between the systems or just use the data from RG 62. That is because the observations used in RG 62 are less good than these observations.

The points already adjusted in the main adjustment which were used in the 2018 second step adjustment are: Algutsboda 1p, Arvidsjaur 1p, Dörby 1p, Eksjö AA, Gällivare AA, Göteborg 1p, Hörnefors 1p, Jokkmokk 1p, Jönköping 1p, Karesuando AA, Kiruna A 1p, Kramfors A, Kramfors AB, Kristianstad 1p, Kåbdalis 1p, Ljusnarsberg AA, Lindesberg 1p, Ludvika 1p, Luleå AA, Pajala 1p, Pello 1p, Skutskär 1p, Stenbrohult 1p, Stora Tuna 1p, Ström 1p, Stugun A, Stugun AA, Stugun B, Sundsvall 1p, Särna 1p, Umbukta AA, Vilhelmina AA, Älvdalen AA, Örebro 1p, Östersund AB and Övertorneå 1p. In the 2019 realization, additionally Bureå 1p, Granberget 1p, Hamrånge 1p, Nysätra 1p, Vassijaure 1p, Vittangi 1p and Örnsköldsvik 1p were adjusted in the main adjustment.

7.2.2 Observations from the 2015 harbour campaign for the FAMOS project

In 2015 Lantmäteriet measured two points each in connection to ten harbours in Sweden (from north to south): Skellefteå, Ljusne, Stockholm, Norrköping, Kalmar, Karlskrona, Ronneby, Karlshamn, Åhus and Ystad. This was done for the FAMOS project (FinAlising surveys for the baltic Motorways Of the Sea), co-financed by the European Union. For every new point, we observed from two points included in RG 2000 with two different instruments. The coordinates of these points can be found in Table 31 in Appendix 2. In order to get a better status for these points, they were included in this adjustment. The instrument Scintrex CG5-198 (repaired in 2011) was just used twice in the 2018 main adjustment and due to that got the scale factor 1.0 there. It was used for nine of these harbours together with the instrument Scintrex CG5-740, whose scale factor had been determined in the main adjustment. The scale factor for CG5-198 was determined through this adjustment and to get a good value of this factor was yet another reason to include the observations in the adjustment. The observations with these instruments were performed by Örjan Josefsson and Fredrik Stedt. The observations in Skelleftehamn were performed by Andreas Engfeldt (LCR G54) and Jakob Jansson (Scintrex CG5-1184), in connection to the FG5 observations at Skellefteå AA.

7.2.3 Additional observations

Among the additional observations, there are observations from 1975 between the RG 62 points Ljusnarsberg AA, Karlstad B 1p, Silbodal A 1p and Oslo A. These were observed with both LCR G54 and LCR G290 and fit badly together, why they were put here. Other observations from 1975 were also put here, since they contained only destroyed points and since one of them (RAK 04 1p) had other equally good observations included here and it felt better to use all of them in the same adjustment. The observations in 1981 between Visby NA, Tjust 1p and Västervik NA, as well as between RAK 04 1p and Södertälje NA, all in connection to the Zero Order Network campaign, were put here since they destroyed the observations for the Zero Order Network they were connected to.

During 2019, old observations with LCR G290 were found when visiting the new Geodetic Archive. These were mainly done in connection to geoid measurements and sometimes they were a part in the geoid measurements. Several of them were from 1977 and observed by Thomas Ahlbeck, a few were from 1990 and observed by Dan Norin or Patric Jansson and a few were from 1995 and observed by Lars Harrie. All of these, either connected RG 62 points to RG 82 First Order Network points or RG 62 points to other RG 62 points and none of these observations were a part in the second step realization in 2018.

For the 2018 realization, also the following observations were moved to this cathegory:

- The observations between Vilhelmina AA, Granberget 1p and Åsele in 1992. The thought at the time, was that the point Granberget 1p is destroyed and these differences deviates a bit more than normal between the instruments.
- The observations in 2008 between Östersund AA and a benchmark outside of the hut, Östersund B, were moved to here due to an imperfectly working instrument (Scintrex CG5-198), and due to that the benchmark is unusable now since the new GNSS mast is now on top of it.
- The observations in 2014. During the gravity measurements for the geoid when a helicopter was used for the transport between the points, one afternoon the weather only allowed measurements by car. Using Björkliden NB as starting and ending point, the RG 62 point Vassijaure 1p was measured among others and this observation is included here.
- The observations in Vittangi 2016. During the RG 2000 campaign, it was found that the benchmark of the RG 62 point Vittangi 1p lately had been moved from the second step from the ground to the top step. Both steps were observed, just in case, and during the first adjustment it was found better to use them as "precomputed differences" than as normal observations. At the time we thought the difference between them otherwise changed too much in comparison to the supposed error in the observation.

7.2.4 RG 62 observations

As stated in Section 2.2 the observations in RG 62 were performed with Worden gravimeters and the observations have been very uneven. The data listed in *Pettersson (1967)* is not the observations, but the adjusted average of the observations. These data can though be used as precomputed differences with a high á priori standard uncertainty and were used that way in the second step adjustment for the 2019 realization of RG 2000 (see Subsection 7.2.6). observation.

7.2.5 Chosen observations for the 2018 realization

All observations in Subsections 7.2.1 to 7.2.3 were included (see Figure 53), except the observations mentioned in Subsection 7.2.3 which were found in 2019.

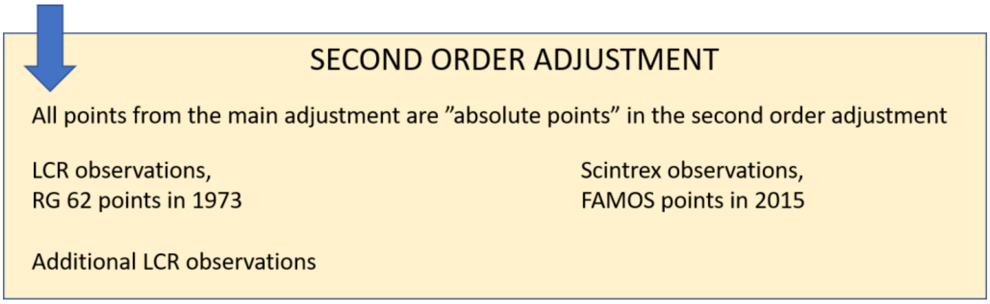

Figure 53: *Summary of the observations included in the Second Step Adjustment in 2018.*

7.2.6 Chosen observations for the 2019 realization

The second step adjustment was done in two different adjustments (see Figure 54), one with only the observations from Subsection 7.2.2 and one with the observations from Subsections 7.2.1, 7.2.3 and 7.2.4. Here, the observations from Subsection 7.2.3 observed in 1992, 2014 and 2016 were not included, since they were already included in the main 2019 realization. More about this realization can be read in Subsection 7.4.2.

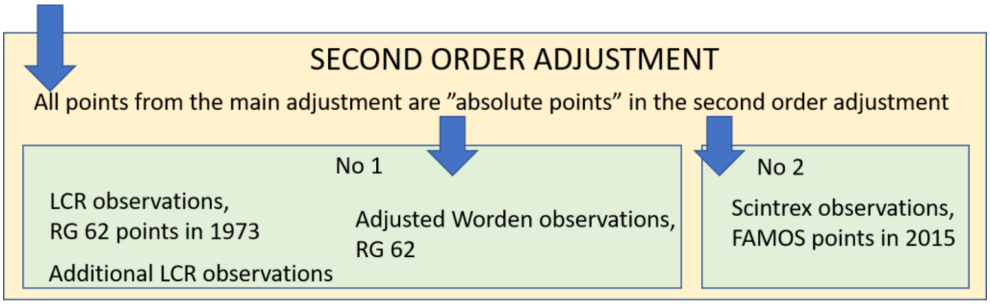

Figure 54: *Summary of the observations included in the Second Step Adjustment in 2019.*

7.3 Gradient measurements

When using the observations at our absolute gravity points as a basis for relative gravimetry, the absolute gravity value normally refers to a bolt (or similar benchmark) on the ground. On the other hand, when observing with and comparing different FG5 instruments, the gravity value is normally given at 1.200 metres above the ground. For transferring the value from 1.200 metres to 0.000 metres as accurately as possible, one must know the vertical gravity gradient. This can be achieved by measuring the gravity difference between as close to 0.000 metres as possible and as close to 1.200 metres as possible with a relative gravimeter.

7.3.1 Gradient measurements for FG5 points

We have used the software VertGrav, originally written by Ludger Timmen and modified by Jonas Ågren into VertGrav_lmv. The software calculates both a linear and a second-degree polynomial gravity change. We have used the second-degree gradient at 1.200 metres for all our FG5 points. Some of the gradient observations refers from IfE’s campaigns in 2004-2008, but most of the observations are performed by Lantmäteriet 2006-2016 (see Figure 55). Only observations from

Scintrex gravimeters have been used. The observations 2006-08 were performed with CG5-198, which quality gradually was degraded. The observations 2011-2014 were performed with CG5-740 and the observations 2015-2016 were performed with CG5-1184. Note that all gradients measurements from 2009 with CG5-198 were removed in the calculations, as well as a few measurements from 2008. Also note that for Holmsund AA, observation series of gradient measurement (done like in Subsection 7.3.2, for A10 points) was performed in 2012 with CG5-740 and all the other observation series of gradient measurements were performed in 2019 with CG5-1184. Table 5 shows the differences between the g-values at 1.200 m and 0.000 m for all the FG5 points, which means the transfer values used in RG 2000 betweeen 1.200 m and 0.000 m, calculated in VertGrav_lmv.

Table 5: *Gradient table for the FG5 points.*

Name	Transfer value used in RG 2000 (µGal)	Gradient at 1.200 m (µGal/cm)
Arjeplog AA	410.3	-3.380
Borås AA	343.5	-2.866
Holmsund AA	389.4	-3.200
Kiruna AA	433.9	-3.639
Kramfors AA	443.8	-3.459
LMV AA	350.6	-2.877
Lycksele AA	397.0	-3.227
Mårtsbo AA	342.7	-2.860
Mårtsbo AB	341.7	-2.830
Onsala AA	394.4	-3.150
Onsala AC	404.2	-3.280
Onsala AN	383.5	-3.180
Onsala AS	383.5	-3.170
Ratan AA	414.9	-3.357
Skellefteå AA	463.8	-3.854
Smögen AA	402.2	-3.340
Visby AA	395.9	-3.214
Östersund AA	420.1	-3.370

Figure 55: *Gradient measurements at Onsala AS in 2007 with Scintrex CG5-198.*

7.3.2 Gradient measurements for A10 points

Only one observation series of totally 12 differences has been performed for the A10 points. The reason is that based on our gradient observations for the FG5 points, we found that the quality will not improve more than a few µGal if making several setups and observation series and estimating a second-degree polynomial gravity change instead of a linear. Since the quality of the A10 observation is between 5 and 10 µGal, the possible improvement is in the noise range of the instrument. One normal setup for gradient measurements is shown in Figure 56.

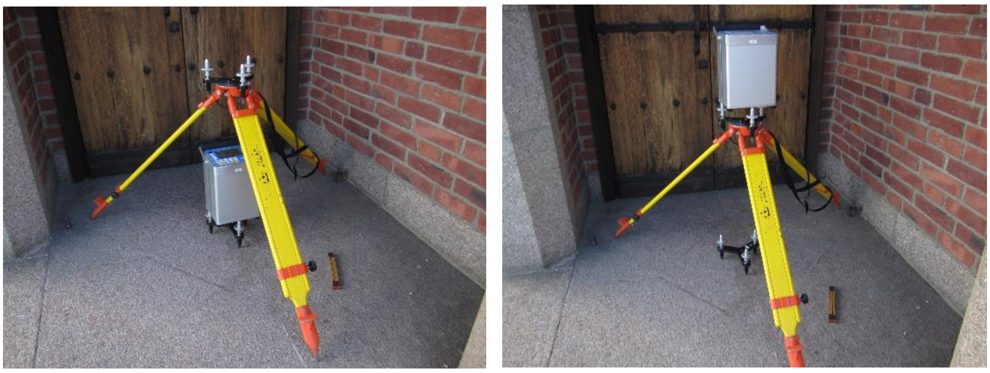

Figure 56: *Gradient measurements at Östersund AB in 2013 with Scintrex CG5-740.*

The observations of the points in the A10 campaigns 2011-2013 were performed in 2011-2014 with CG5-740 and the observations of the points in the A10 campaign

2015 were performed the same year with CG5-1184. The observed and used gradients for the A10 points can be found in *Engfeldt (2016a).*

7.4 The new RG 2000 realization in 2019

During the work on the report, new discoveries and new data led to the decision of making a new realization of RG 2000. They were:

1. As can be seen in Figure 60, Figure 61 and Subsection 10.1.1, there was a gross error in Holmsund AA which was either due to the A10 observation or the relative observations between Holmsund AA and Ratan AA (see Appendix 1). Since Holmsund AA can host an FG5, the decision was taken in early 2019 to observe it with FG5X in June 2019, directly after observations in Ratan AA, so that the FG5X could be used as a very good relative gravimeter. The result (see further down) corresponded much better with the earlier relative observations, which meant that the A10 observation was biased and that the RG 2000 value of Holmsund AA needed to be changed.
2. Early in 2019, a few small errors in the used FG5 data were found. Also, the FG5-220 data was not adjusted like the FG5-233 data, in particular from the comparison in Onsala in 2014 (see further down), which was inconsistent. After the summer of 2019, some absolute gravity data used for the first realization of RG 2000 was found to disagree with the data used in *Olsson et al. (2019).*
3. Construction work for a new parking lot was done around the hut in Smögen AA after the observations in 2013 (see Figure 57). Before a large rock mass was removed, the contours of the bedrock were measured with GNSS by Andreas Engfeldt and Fredrik Dahlström. Similar measurements were done after the mass was removed by Andreas Engfeldt and Holger Steffen in 2014. Calculations by Jonas Ågren showed that the g-value should become 1-2 µGal lower due to the missing rock mass. However, the observation in 2015 showed a change in g of about +6 µGal and should be considered as an outlier and should therefore be removed from the average. In June 2018, Smögen AA was observed again, now for the first time after the upgrade to FG5X. This observation could finally be calculated after we in August 2019 got our intercomparison value from EURAMET 2018. The 2018 observation showed almost no difference at all to the calculated mean value in epoch 2000.0, which complicated the determination of the best value for Smögen AA. However, as the only relative observation performed in Smögen AA was in 2017, connecting it to the network and the point Uddevalla, we now decided that the g-value after the construction work should be used and that the observation from 2015 should be removed from the data.

Figure 57: *The area around Smögen AA in 2013 (left) and in 2014 (right).*

4. The first RG 2000 realization included observations by Lars Åke Haller from 1991 between the (at the time) new FG5 point Skellefteå AA and the RG 82 Zero Order Network points Jävre NA and Sävar A (nowadays Sävar AA). For the observations with the instrument G54, everything was calculated the correct way. But for the instrument G290, the year in the obs-file for the Gred2 software was not changed in the header from 1990 to 1991 as it should (the file was at start copied from a file with some observations in Örebro in 1990). This led to wrong tidal corrections and thus either unusable (for one of the days) or wrongly inputed (for the other days) data. This mistake was corrected.
5. After the FG5X observations at Holmsund AA in 2019, which showed that the A10 observation was flawed, the á priori standard uncertainties for the A10 observations were questioned. New relative observations in September 2019 were therefore performed with all four instruments to verify the A10 observation at Klimpfjäll AA. However, the relative instruments, apart from CG5-198 (which was hardly used in the RG 2000 work), normally did not perform well after the end of August 2019. Here, the observations with CG5-198 and CG5-1184 followed each other very well and were considered as good observations. Of the observations with G54 and CG5-740 only 50% each could be used.
6. New relative gravity observations were performed in June and August 2019, mainly in connection to absolute gravity campaigns. Here, new points outside the huts in Onsala and Lycksele and outside of Lantmäteriet’s headquarter have been established. Also, connections to four RG 62 points (with previously low-quality RG 2000 value) have been established as well as one observation in the Västerbotten area between already observed points in order to strengthen the network there. Finally, the point Lycksele C was observed relatively to Lycksele A.
7. In August 2019, several new dossiers were found in the Geodetic archive after its renovation, containing connections between different RG 62 points. In these dossiers, also the missing observations between the main points and the spare points of the RG 82 Zero Order Network were found, including the old and never calculated observations between Lycksele A and Lycksele C. After making the calculation of the recently found observations, the author found that they were separated up to almost 8 µGal from what was used as precomputed differences before and by using them the same way as all other data designed for the RG 82 campaigns, they will get the correct weight in another realization.

The issues addressed in the Subsections 7.4.1 – 7.4.5 are also summarized in Subsection 9.5.1 and Subsection 9.5.2.

7.4.1 Differences in absolute data between the two RG 2000 realizations

The FG5-220 data between 2004-08 was all changed by -2.5 µGal according to the result from ECAG 2007 (the result there was +2.5). The instrument was not on service between these years.

The FG5-220 data in 2009 was changed by -1.7 µGal, according to ICAG 2009 and the FG5-220 data in 2010-11 were changed by -1.8 µGal according to ECAG 2011. These years, only observations in Onsala were performed. In 2012, this instrument was upgraded to FG5X.

The FG5X-220 data from 2014 and 2015 was all changed by -2.3 µGal according to the results from ICAG 2013 (the result there was +2.3 µGal). In an initial test the

FG5X-220 data from 2015 was changed by -5.2 µGal according to the results from ICAG 2013 more reliable than the EURAMET 2015 results due to the better stability of the ICAG 2013 points, this value was chosen eventually for both 2014 and 2015. However, when looking at the overall results, it seems that the value from EURAMET 2015 is more appropriate to be applied to both the 2014 and 2015 campaigns (see Table 2 in Section 5.2 and Table 25 in Appendix 2).

The FG5-233 data from 2015 and 2016 was all changed by -0.3 µGal, since the value from ICAG 2013 (2.2 µGal) had been used here and in *Olsson et al. (2019)* instead of the factor from EURAMET 2015 (2.5 µGal).

Added data: The observations in Kiruna AA in 2008, since they were missing in the first realization.

Removed data: The observation of Mårtsbo AB in 2011 previously included also in the Mårtsbo AA data; The observation of Borås AA in 2008, since it could be regarded as an oulier; The observation of Smögen AA in 2015, since it could be regarded as an outlier; The A10 observation of Holmsund AA.

7.4.2 Differences in relative data between the two RG 2000 realizations

Changed data: The observations in 1991 with G290.

Added data: Many previously removed observations; The observations with G290 and G54 between the main and the spare points of the RG 82 Zero Order Network not included in the land uplift gravity lines; All observations from 2019 with CG5-1184, CG5-740, CG5-198 and G54; More “calibration measurements” between LMV AA and Husby-Ärlinghundra AA and Boda Bruk AA. In Table 23 in Appendix 2, all used observations can be found.

7.4.3 Differences in precomputed differences between the two RG 2000 realizations

Added data: The FG5X difference between Ratan AA and Holmsund AA, which was given the á priori standard uncertainty 2 µGal.

Removed data: The differences between the main and the spare points of the RG 82 Zero Order Network previously taken from the RG 82 adjustment.

7.4.4 Differences in á priori standard uncertainties between the two RG 2000 realizations

FG5: Instead of 1.0 µGal for all, the á priori standard uncertainty from the standard uncertainty of the observations in question is used at the epoch 2000.0 (see Table 6). For Borås AA and Onsala AN there were too few observations which gave a too low number, thus 2 µGal was still used for them.

A10: 7.0 µGal as á priori standard uncertainty for all observations.

Relative observations: Here, all observations were thoroughly checked again concerning both the previously removed observations and the á priori standard uncertainties for the observations previously considered as less good. The recently added relative observations got the á priori standard uncertainty in accordance to the previous rules.

Precomputed differences: 7.0 µGal as the standard á priori standard uncertainty.

Table 6: *The used initial g-values and á priori standard uncertainties in mGal.*

Name	New initial g-value	Standard uncertainty
Arjeplog AA	982253.5772	0.00156
Borås AA	981680.0483	0.00200
Kiruna AA	982337.1846	0.00128
Kramfors AA	982075.4086	0.00119
LMV AA	981935.1863	0.00183
Lycksele AA	982196.7413	0.00145
Mårtsbo AA	981923.4362	0.00204
Mårtsbo AB	981923.4420	0.00162
Onsala AA	981716.2947	0.00144
Onsala AC	981716.3107	0.00137
Onsala AN	981716.6087	0.00142
Onsala AS	981716.6025	0.00200
Ratan AA	982188.9987	0.00157
Skellefteå AA	982230.3955	0.00165
Smögen AA	981770.1918	0.00159
Visby AA	981714.3959	0.00135
Östersund AA	982045.0481	0.00181

7.4.5 Differences in instruments between the two RG 2000 realizations

After some new data was added, the scale factor of G290L and G290Y got almost the same value, so the two instruments were merged into one. The scale factors of G54L and G54Y differed more from each other but were still close. It was also decided to merge them into one instrument, where the new instrument got almost the identical value as G54Y previously had. For explanation of what the instruments were called in the adjustment, see Table 4.

CG5-198 was our first Scintrex CG5 instrument and was on repair twice, first in 2011 and then in 2016. In the 2018 main adjustment it was only used for two observation series. The first one was in 2008 for observations between Kramfors AA and Kramfors AB, where the gravity range was below 1 mGal. The second one was in 2014 for observations between Saxnäs and Klimpfjäll AA, simultaneously with CG5-740. There the gravity range was higher, but still only about 6 mGal. It means that no valid scale factor could be determined. Therefore, CG5-198 got the scale factor 1.000000 in the 2018 adjustment. It should also be mentioned that the instrument had started to behave strangely in the autumn of 2008, when the observations in Kramfors were performed.

In autumn 2019, it was noted that CG5-198 had become the most reliable of our gravimeters. Therefore, it was brought for the first time when performing observations dedicated to RG 2000. In the main adjustment in 2019, some more observations with CG5-198 from 2008 were added, all with the double normal standard uncertainty. There was a small risk that these might destroy the new and better observations from 2019, so it was decided to use two different scale factors for the new and the old observations with this instrument. The scale factor for the CG5-198 observations in 2019 was derived in the software and named CG5-198X. The scale factor for the earlier observations with CG5-198 was first taken from the former second adjustment of RG 2000. There, many more observations were performed and therefore the scale factor got a lower uncertainty than it would if it would have been determined here. After two rounds of iteration between the main and the second step adjustment, the value for this scale factor was set.

7.4.6 Additional differences between the two RG 2000 realizations

19 drift parameters were added (of which 17 belong to added observations) and 4 drift parameters were removed for the Scintrex observations. 21 drift parameters were added (of which 17 belong to added observations) for the LCR observations. The á priori standard uncertainty was changed for 21 Scintrex observations and 514 LCR observations, mostly to lower values. The total number of relative observations increased by 403 with 152 additional Scintrex observations and 251 additional LCR observations. 1 precomputed difference was added and 19 precomputed differences were removed.

7.4.7 Points in the 2019 realization, only observed with relative gravimeters

Here is a description of the points used in the 2019 realization which only were observed with relative gravimeters. All points are benchmarks for heights unless something else is indicated in the description.

Alby: The point was first used in 2002 as an RG 82 First Order Network point and was situated on a large stone some kilometres east of the small village Alby in Medelpad. During the reconnoitering in 2011 it was found destroyed due to construction work for new water tubes. The point was relatively connected to the RG 82 First Order Network points Stavre and Torpshammar.

Algutsboda 1p: The point was included in RG 62 and is not a benchmark, but is situated on a church step. Here the measures to the door and the wall is written in

Pettersson (1967). The point is relatively connected to the A10 point Emmaboda AA.

Ammarnäs: The point was first used in 2001 as an RG 82 First Order Network point and is situated on a large stone some kilometres southeast of the village Ammarnäs. The point is relatively connected to the RG 82 Zero Order Network point Stensele B.

Aneby: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a large stone at ground height some kilometres south of the village Aneby. The point is relatively connected to the A10 point Eksjö AA, the RG 82 Zero Order Network point Ödeshög NA and the RG 82 First Order Network point Sävsjö.

Arbrå: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a large stone some kilometres south of the village Arbrå. The point is relatively connected to the FG5 point Mårtsbo AA, the A10 point Bollnäs AA and the RG 82 First Order Network point Laforsen.

Arjeplog: The point was first used in 2001 as an RG 82 First Order Network point and is situated on a large stone at a property in the village Arjeplog. The point is relatively connected to the FG5 point Arjeplog AA, the A10 point Arjeplog AB and the RG 82 First Order Network points Jäkkvik and Sorsele.

Arjeplog B: The point was first used in 2017 as a new point and is situated on bedrock within 20 metres from the FG5 point Arjeplog AA, to which it is relatively connected.

Arvidsjaur: The point was first used in 2001 as an RG 82 First Order Network point and is situated on a large stone in the wood next to the police station in the village Arvidsjaur. In 2011 the point was still in place, but in 2013 just before it was about to be observed with the A10 we found that the bolt was severely damaged, probably due to a snow plough car. The point was thus relatively connected to the new A10 point Arvidsjaur AA. It is also relatively connected to the A10 point Kåbdalis AA, the RG 82 First Order Network points Burträsk and Gällivare and the RG 62 point Jokkmokk 1p.

Arvidsjaur 1p: The point was first used in the 1960s as an RG 62 point and is not a benchmark, but is situated on a step outside the entrance of Arvidsjaur church. The point is relatively connected to the A10 point Arvidsjaur AA.

Arvika: The point was first used in 1985 as an RG 82 First Order Network point and is situated on bedrock some kilometres east of the village Arvika. The point is relatively connected to the A10 points Karlstad AA and Årjäng AA and the RG 82 Zero Order Network point Karlstad NA.

Avesta: The point was first used in 2001 as an RG 82 First Order Network point and is situated on bedrock in a small wood in the town Avesta. The point is relatively connected to the A10 point Grytnäs AA, the RG 82 Zero Order Network point Hofors B and the RG 82 First Order Network points Tärnsjö and Uppsala.

Bergnäset: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock in a small forest about a kilometer west of the village

Bergnäset. The point is relatively connected to the A10 points Hundsjön AA and Luleå AA, the RG 82 Zero Order Network point Jävre NB and the RG 82 First Order Network points Kalix and Haparanda.

Björkliden NA: The point was first used in 1981 as an RG 82 Zero Order Network main point and is situated on bedrock. It is not the best suitable point to access, since one must walk along the E14 for 200 metres from the next possible parking place. Therefore, Björkliden NB is recommended if a point in this area is needed. The point is relatively connected to the RG 82 Zero Order Network points Björkliden NB and Jukkasjärvi NA.

Björkliden NB: The point was first used 1985 as an RG 82 Zero Order Network spare point and is situated on bedrock some kilometres northwest of the village Björkliden. The point is relatively connected to the RG 82 Zero Order Network point Björkliden NA, the RG 82 First Order Network point Torneträsk and the RG 62 point Vassijaure 1p.

Björna: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a large stone about four kilometer north of the small village Björna. The point is relatively connected to the A10 point Hörnefors AA and the RG 82 First Order Network point Åte.

Blomstermåla: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock some kilometres northwest of the village Blomstermåla. The point is relatively connected to the A10 point Misterhult AA, the RG 82 First Order Network point Åseda and the RG 62 point Mönsterås 1p.

Boda: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a large stone about two kilometres north of the small village Boda in Medelpad. The point is relatively connected to the RG 82 Zero Order Network point Stugun A and the RG 82 First Order Network point Torpshammar.

Bofors: The point was first used in 1990 as an RG 82 First Order Network point and is situated on bedrock close to the Bofors industrial area in Karlskoga. The point is relatively connected to the RG 82 Zero Order Network point Karlstad NA and the RG 82 First Order Network point Örebro.

Borgholm: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a large stone in the eastern part of the village Borgholm. The point is relatively connected to the A10 points Köpingsvik AA and Ljungbyholm AA and to the RG 82 First Order Network points Kastlösa and Torsås.

Borlänge: The point was first used in 2001 as an RG 82 First Order Network point and is situated on bedrock in the eastern parts of Borlänge. The point is relatively connected to the A10 point Leksand AA, the RG 82 Zero Order Network point Hofors B, the RG 82 First Order Network point Rättvik and the RG 62 point Stora Tuna 1p.

Borås: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock between the town Borås and the small village Sandhult northwest of Borås. The point is relatively connected to the FG5 point Borås AA, the RG 82 Zero Order Network point Göteborg NB, the RG 82 First Order Network points Svenljunga and Veddige and the RG 62 point Borås 1p.

Borås 1p: The point was first used in the 1960s as an RG 62 point and is not a benchmark, but is situated on a step outside the entrance of Caroli church in Borås. The point is relatively connected to the FG5 point Borås AA and the RG 82 First Order Network point Borås.

Bottnaryd: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock about a kilometre south of the village Bottnaryd. The point is relatively connected to the A10 points Baltak AA, Ulricehamn AA and Vara AA and the RG 82 Zero Order Network point Ödeshög NA.

Bunge: The point was first used in 1984 as an RG 82 First Order Network point and is marked by a carved cross in a church step at Bunge church. The point is relatively connected to the RG 82 Zero Order Network point Visby NA and the RG 82 First Order Network points Gothem and Gotska Sandön.

Burträsk: The point was first used in 2001 as an RG 82 First Order Network point and is situated on a stone in the southwest part of the village Burträsk. The point is relatively connected to the FG5 point Skellefteå AA, the A10 point Bureå AA, the RG 82 Zero Order Network point Jävre NB and the RG 82 First Order Network point Arvidsjaur.

Dala: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a large stone in a small forest close to the village Dala. The point is relatively connected to the A10 points Baltak AA and Mariestad AA, the RG 82 Zero Order Network point Ödeshög NA and the RG 62 point Södra Fågelås 1p.

Dalby: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a large stone in a forest some kilometres north of the village Dalby. The point is relatively connected to the A10 points Helsingborg AA, Maglarp AA and Simrishamn AA and the RG 82 First Order Network point Åstorp.

Dals Ed: The point was first used in 1985 as an RG 82 First Order Network point and is situated on bedrock in the east part of the village Dals Ed. The point is relatively connected to the A10 points Klöveskog AA, Säffle AA, Tanum AA and Årjäng AA and the RG 82 First Order Network points Tanum and Uddevalla.

Dörby 1p: The point was first used in the 1960s as an RG 62 point and is not a benchmark, but is situated on a step outside the entrance of Dörby church. The point is relatively connected to the A10 point Ljungbyholm AA.

Edefors: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a large stone a couple of kilometres west of the small village Edefors. The point is relatively connected to the A10 point Hundsjön AA and the RG 82 First Order Network point Älvsbyn.

Ekshärad: The point was first used in 1985 as an RG 82 First Order Network point and is situated on bedrock in the west part of the village Ekshärad. The point is relatively connected to the A10 points Fryksände AA and Munkfors AA and the RG 82 First Order Network point Torsby and the RG 62 point Lindesberg 1p.

Enköping: The point was first used in 1990 as an RG 82 First Order Network point and is situated on bedrock some kilometres northwest of the town Enköping. After 2011, a fence was put in the middle of the big road next to the point, which makes it forbidden to stop close to the point. If a point is needed in the Enköping area, Svinnegarn AA is recommended. The point is relatively connected to the RG 82 Zero Order Network point Södertälje NA and the RG 82 First Order Network points Hallstahammar and Solna.

Eskilstuna: The point was first used in 1990 as an RG 82 First Order Network point and is situated on bedrock in the southwest part of the town Eskilstuna. The point is relatively connected to the A10 point Valla AA, the RG 82 Zero Order Network point Södertälje NA and the RG 82 First Order Network point Hallstahammar.

Fredrika: The point was first used in 1992 as an RG 82 First Order Network point and is situated on bedrock some kilometres north of the village Fredrika. In the early 2000s, the rock the point is situated on was partly buried by sand/gravel, which means that the point probably has another g-value now. The point is relatively connected to the RG 82 Zero Order Network point Lycksele A and the RG 82 First Order Network point Åsele.

Föllinge A: The point was first used in 1979 in the 63rd degree land uplift gravity line and became in 1981 an RG 82 Zero Order Network main point. It is situated on bedrock about one kilometer west of the village Föllinge. The point is relatively connected to the A10 point Sved AA, the RG 82 Zero Order Network points Stensele A, Stugun B and Älvdalen A, the RG 82 First Order Network points Gäddede, Hallviken and Hoting and the RG 62 point Ström 1p.

Föllinge B: The point was first used in 1981 in the 63rd degree land uplift gravity line and became in the same year an RG 82 First Order Network spare point. It is situated on bedrock about 100 metres north east of Föllinge A. The point is relatively connected to the FG5 point Östersund AA, the RG 82 First Order Network point Krokom and the new point Östersund B.

Garde: The point was first used in 1984 as an RG 82 First Order Network point and is marked by a carved cross in a church step at Garde church. The point is relatively connected to the FG5 point Visby AA, the RG 82 Zero Order Network point Visby NB and the RG 82 First Order Network points Gothem and Hemse 1p.

Gnarp: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a large stone in a small wood, in the northeast corner of the village Gnarp. The point is relatively connected to the A10 points Boda Bruk AA and Sundsvall AA and the RG 82 First Order Network point Vallvik.

Gothem: The point was first used in 1984 as an RG 82 First Order Network point and is marked by a carved cross in a church step at Gothem church. In 2015 it was discovered that this step had been covered by a permanent large wooden construction making it inaccessible. The point is relatively connected to the RG 82 Zero Order Network point Visby NA and the RG 82 First Order Network points Bunge and Garde.

Gotska Sandön: The point was first used in 1984 as an RG 82 First Order Network point and is situated on a large stone. The point is relatively connected to the RG 82 First Order Network point Bunge.

Grythyttan: The point was first used in 1990 as an RG 82 First Order Network point and is situated on bedrock in a forest a kilometer north of the village Grythyttan. The point is relatively connected to the A10 point Ljusnarsberg AA, the RG 82 Zero Order Network point Karlstad NA and the RG 82 First Order Network point Ludvika.

Grötlingbo: The point was first used in 1984 as an RG 82 First Order Network point and is marked by a carved cross in a church step at Grötlingbo church. The point is relatively connected to the RG 82 Zero Order Network point Visby NA and the RG 82 First Order Network point Hemse 1p.

Gulsele: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a large stone about one kilometer east of the small village Gulsele. The point is relatively connected to the A10 points Junsele AA, Kramfors AB and Åsele AA and the RG 82 First Order Network points Ramsele and Sollefteå.

Gäddede: The point was first used in 1992 as an RG 82 First Order Network point and is situated on bedrock about 10 kilometres southeast of the village Gäddede. The point is relatively connected to the A10 point Sved and the RG 82 Zero Order Network point Föllinge A.

Gällivare: The point was first used in 2001 as an RG 82 First Order Network point and is situated on a stone about one kilometer southwest of the village Gällivare. The point is relatively connected to the A10 point Gällivare AA, the RG 82 Zero Order Network point Jukkasjärvi NA and the RG 82 First Order Network point Porjus.

Göteborg A: The point was first used in 1976 as an RG 82 Zero Order Network point and is situated on a concrete floor in the basement of a house at Chalmers University of Technology in the city of Göteborg. The point is relatively connected to the RG 82 Zero Order Network point Göteborg NB.

Göteborg 1p: The point was first used in the 1960s as an RG 62 point and is not a benchmark, but is situated on a step outside the entrance of Christine church in Göteborg. The point is relatively connected to the RG 82 Zero Order Network point Göteborg NB.

Göteborg NB: The point was first used in 1981 as an RG 82 Zero Order Network main point and is situated on bedrock, about 50 metres west of Chalmers University of Technology in the city of Göteborg. The point is relatively connected to the FG5 point Onsala AA, the A10 point Grinneröd AA, the RG 82 Zero Order Network point Göteborg AA, the RG 82 First Order Network points Borås, Uddevalla and Veddige and the RG 62 point Göteborg 1p.

Hakkas: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a large stone in the forest in the very southeast part of the village Hakkas. The point is relatively connected to the A10 point Gällivare AA, the

RG 82 Zero Order Network point Jukkasjärvi NA and the RG 82 First Order Network point Lansån.

Hallstahammar: The point was first used in 1990 as an RG 82 First Order Network point and is situated on a large stone in a small forest in the northwest part of the village Hallstahammar. The point is relatively connected to the A10 points Arboga AA and Svinnegarn AA and the RG 82 First Order Network points Enköping and Eskilstuna.

Hallviken: The point was first used in 1992 as an RG 82 First Order Network point and is situated on bedrock in the forest some kilometres north of the small village Hallviken. The point is relatively connected to the A10 point Hammerdal AA, the RG 82 Zero Order Network point Föllinge A and the RG 82 First Order Network point Hoting.

Haparanda: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a large stone in the forest some kilometres west of the town Haparanda. The point is relatively connected to the A10 point Haparanda AA and the RG 82 First Order Network points Kalix and Bergnäset.

Hede: The point was first used in 2001 as an RG 82 First Order Network point and is situated on a very large stone about three kilometres east of the village Hede. The point is relatively connected to the A10 points Hede AA and Sveg AA and the RG 82 First Order Network points Rätansbyn, Sveg and Tännäs.

Hemavan: The point was first used in 2001 as an RG 82 First Order Network point and is situated on bedrock about a kilometre north of the village Hemavan. The point is relatively connected to the A10 point Umbukta AA, the RG 82 Zero Order Network point Umbukta A and the RG 82 First Order Network point Tärnaby.

Hemse 1p: The point was first used in 197X as one of seven points on Gotland measured by Lennart Pettersson. In 1984 it was observed again and became an RG 82 First Order Network point. First the day before this report was finished, the point description was found in a protocol book. The point is relatively connected to the RG 82 First Order Network points Garde and Grötlingbo.

Hillerstorp: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock in a forest in the western part of the village Hillerstorp. The point is relatively connected to the A10 point Kärda AA, the RG 82 Zero Order Network point Ödeshög NA and the RG 82 First Order Network point Ör.

Hofors A: The point was first used in 1976 in the 61st degree land uplift gravity line and became in 1981 an RG 82 Zero Order Network main point. It was situated on bedrock in the outskirts of a forest some kilometres east of the village Hofors. In the 1990s the point was destroyed during some construction work in the area. The point was relatively connected to the FG5 point Mårtsbo AA and the RG 82 Zero Order Network points Hofors B, Älvdalen A and Östhammar A.

Hofors B: The point was first used in 1977 in the 61st degree land uplift gravity line and became in 1981 an RG 82 Zero Order Network spare point. It is situated on bedrock in a forest some hundred metres south of Hofors A, to which it is relatively connected. The point is also relatively connected to the FG5 point LMV AA, the A10 point Grytnäs AA and the RG 82 First Order Network points Avesta and Borlänge.

Hoting: The point was first used in 1992 as an RG 82 First Order Network point and is situated on bedrock some five kilometres southeast of the village Hoting (see Figure 43). The point is relatively connected to the A10 point Vilhelmina AA, the RG 82 Zero Order Network point Föllinge A, the RG 82 First Order Network point Hallviken and the RG 62 point Ström 1p.

Hybo: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a large stone about 100 metres north of Hybo railway station. The point is relatively connected to the FG5 point Mårtsbo AA, the A10 points Boda Bruk AA and Ljusdal AA and the RG 82 First Order Network point Laforsen.

Hällnäs: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock about a kilometre north of the village Hällnäs. The point is relatively connected to the A10 point Bjurholm AA and the RG 82 First Order Network point Norsjö.

Hörnefors 1p: The point was first used in the 1960s as an RG 62 point and is not a benchmark, but is situated on a step outside the entrance of Hörnefors church. The point is relatively connected to the A10 point Hörnefors AA.

Höör A: The point was first used in 1977 in the 56th degree land uplift gravity line and became in 1981 an RG 82 Zero Order Network main point. It is situated on bedrock in a forest some kilometres north of the village Höör. The point was not found in 2002 and 2003 as it is covered by a thick layer of leaves and soil. The point is relatively connected to the RG 82 Zero Order Network points Göteborg NB, Höör B and Sölvesborg A.

Höör B: The point was first used in 1977 in the 56th degree land uplift gravity line and became in 1981 an RG 82 Zero Order Network spare point. It is situated on bedrock in a forest some kilometres north of the village Höör (see Figure 40). The point is relatively connected to the A10 points Höör AA and Simrishamn AA and the RG 82 Zero Order Network point Sölvesborg A and the RG 82 First Order Network points Laholm, Osby and Åstorp.

Idre: The point was first used in 2001 as an RG 82 First Order Network point and is situated on bedrock in the forest some five kilometres west of the village Idre. The point is relatively connected to the A10 point Särna AA and the RG 82 First Order Network points Lofsdalen and Särna.

Johannishus: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock in the forest some kilometres south of the village Johannishus. The point is relatively connected to the A10 points Augerum AA and Emmaboda AA and the RG 82 Zero Order Network point Sölvesborg A.

Jokkmokk: The point was first used in 2001 as an RG 82 First Order Network point and is situated on a large stone in a small wood in the very middle of the village Jokkmokk. The point is relatively connected to the A10 points Gällivare AA and

Kåbdalis AA, the RG 82 Zero Order Network point Kvikkjokk NB and the RG 62 point Jokkmokk 1p.

Jokkmokk 1p: The point was first used in the 1960s as an RG 62 point and is not a benchmark, but is situated on a step outside the entrance of the new church in Jokkmokk. The point is relatively connected to the RG 82 First Order Network point Jokkmokk.

Jordbro: The point was first used in 1990 as an RG 82 First Order Network point and is situated on bedrock in a forest in the west part of the village Jordbro. The point is relatively connected to the A10 point Tullinge AA, the RG 82 Zero Order Network point Södertälje NA and the RG 82 First Order Network point Solna.

Jukkasjärvi NA: The point was first used in 1981 as an RG 82 Zero Order Network main point and is situated on bedrock some kilometres west of the village Jukkasjärvi. The point is relatively connected to the FG5 point Kiruna AA, the A10 points Gällivare AA and Kåbdalis AA, the RG 82 Zero Order Network points Björkliden NA, Jukkasjärvi NB, Kvikkjokk NA and Pello NA, the RG 82 First Order Network points Gällivare, Hakkas, Karesuando, Soppero, Torneträsk and Vittangi and the RG 62 point Kiruna A 1p.

Jukkasjärvi NB: The point was first used in 1985 as an RG 82 Zero Order Network spare point and is situated on bedrock in the forest some hundred meters west of Jukkasjärvi NA, to which it is relatively connected.

Junosuando: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a large stone in the forest some kilometres west of the village Junosuando. The point is relatively connected to the A10 point Tärendö AA and the RG 82 First Order Network points Korpilombolo, Pajala and Vittangi.

Jäkkvik: The point was first used in 2001 as an RG 82 First Order Network point and is situated on a large stone in the forest some kilometres northwest of the village Jäkkvik. The point is relatively connected to the A10 point Arjeplog AB, the RG 82 Zero Order Network point Stensele B and the RG 82 First Order Network point Arjeplog.

Jämjö 1p: The point was first used in the 1960s as an RG 62 point and is an engraved cross situated on a step of Jämjö church. The point is relatively connected to the A10 point Augerum AA.

Järpen: The point was first used in 2001 as an RG 82 First Order Network point and is situated on bedrock in the north part of the village Järpen. The point is relatively connected to the A10 point Duved AA, the RG 82 Zero Order Network point Stugun A, the RG 82 First Order Network points Krokom, Rätansbyn and Ånn and the new point Östersund B.

Jävre NA: The point was first used in 1981 as an RG 82 Zero Order Network main point and is situated on bedrock in the north part of the village Jävre. The point is relatively connected to the FG5 point Skellefteå AA, the A10 points Kåbdalis AA and Sävar AA and the RG 82 Zero Order Network points Jävre NB and Pello NA.

Jävre NB: The point was first used in 1985 as an RG 82 First Order Network spare point and is situated on bedrock on a mountain in a forest in the southwest corner of the village Jävre. The point is relatively connected to the A10 points Hundsjön AA and Kåbdalis AA, the RG 82 Zero Order Network point Jävre NA, the RG 82 First Order Network points Bergnäset, Burträsk, Kalix, Lidträsk, Lövånger and Älvsbyn and the new point Skellefteå B.

Jönköping 1p: The point was first used in the 1960s as an RG 62 point and is not a benchmark, but is situated on a step outside the entrance of Sofia church in Jönköping. The point is relatively connected to the RG 82 Zero Order Network point Ödeshög NA.

Kalix: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a large stone some five kilometres northwest of the village Kalix. The point is relatively connected to the A10 points Haparanda AA and Hundsjön AA, the RG 82 Zero Order Network point Jävre NB and the RG 82 First Order Network points Bergnäset, Haparanda and Lansån.

Karesuando: The point was first used in 2002 as an RG 82 First Order Network point and is situated in the forest on a large stone some kilometres southwest of the village Karesuando. The point is relatively connected to the A10 point Karesuando AA, the RG 82 Zero Order Network point Jukkasjärvi NA and the RG 82 First Order Network point Soppero.

Karlstad NA: The point was first used in 1981 as an RG 82 Zero Order Network main point and is situated on bedrock in a forest in the south part of the town Karlstad. The point is relatively connected to the A10 points Fredriksberg AA, Karlstad AA, Laxå AA, Munkfors AA, Stöllet AA and Säffle AA, the RG 82 Zero Order Network points Södertälje NA and Älvdalen NA, the RG 82 First Order Network points Arvika, Bofors and Grythyttan and the RG 62 point Norra Råda 1p.

Kastlösa: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a stone some kilometres east of the village Mörbylånga and some more kilometres north of the village Kastlösa. The point is relatively connected to the A10 point Köpingsvik AA, the RG 82 Zero Order Network point Västervik NA and the RG 82 First Order Network point Borgholm.

Kiruna A 1p: The point was first used in the 1960s as an RG 62 point and is not a benchmark, but is situated on a step outside the entrance of Kiruna church. Note that the mine after the 1980s has grown rapidly and is under the church now. The g-value of the point has very likely changed. The point is relatively connected to the RG 82 Zero Order Network point Jukkasjärvi NA.

Kisa: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock some kilometres west of the village Kisa. The point is relatively connected to the A10 point Rimforsa AA, the RG 82 Zero Order Network Network point Ödeshög NA and the RG 82 First Order Network points Lönneberga and Åtvidaberg.

Korpilombolo: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a stone about three kilometres south of the village Korpilombolo. The point is relatively connected to the A10 point Övertorneå AA and the RG 82 First Order Network point Pajala.

Kramfors A: The point was first used in 1967 in the 63rd degree land uplift gravity line and became in 1981 an RG 82 Zero Order Network spare point. It is situated on bedrock in a forest. The point is relatively connected to the A10 points Kramfors AB and Sävar AA and the RG 82 Zero Order Network point Stugun B.

Kramfors B: The point was first used in 1967 in the 63rd degree land uplift gravity line and became in 1981 an RG 82 Zero Order Network spare point. It is situated on bedrock in a forest. The point is relatively connected to the A10 point Kramfors AB.

Kramfors C: The point was first used in 1967 in the 63rd degree land uplift gravity line and became in 1981 an RG 82 Zero Order Network spare point. It is situated on bedrock in a forest. The point is relatively connected to the A10 point Kramfors AB.

Kristianstad 1p: The point was first used in the 1960s as an RG 62 point and is not a benchmark, but is situated on a step outside the entrance of Kristianstad church. The point is relatively connected to the RG 82 Zero Order Network point Sölvesborg A.

Krokom: The point was first used in 2001 as an RG 82 First Order Network point and is situated on a stone a couple of kilometres northeast of the village Krokom. The point is relatively connected to the FG5 point Östersund AA, the RG 82 Zero Order Network points Föllinge B and Stugun A and the RG 82 First Order Network points Järpen and Ånn.

Kvikkjokk NA: The point was first used in 1981 as an RG 82 Zero Order Network main point and is situated on a large stone in the western part of the small village Kvikkjokk. The point is relatively connected to the A10 point Kåbdalis AA and the RG 82 Zero Order Network points Jukkasjärvi NA and Kvikkjokk NB.

Kvikkjokk NB: The point was first used in 1985 as an RG 82 Zero Order Network spare point and is situated on bedrock about 100 metres north west of Kvikkjokk NA, to which it is relatively connected. The point is also relatively connected to the A10 point Kåbdalis AA and the RG 82 First Order Network point Jokkmokk.

Kåbdalis 1p: The point was first used in the 1960s as an RG 62 point and is not a benchmark, but is situated on a step outside the entrance of the chapel in Kåbdalis. The point is relatively connected to the A10 point Kåbdalis AA.

Kåbdalis NB: The point was first used in 1985 as an RG 82 Zero Order Network spare point and is situated on a large stone in the forest some five kilometres south west of the village Kåbdalis. The point is relatively connected to the A10 point Kåbdalis AA.

Laforsen: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a large stone a few metres south of the river Ljusnan, about two kilometres west of the small village Laforsen. The point is relatively connected to the A10 point Ljusdal AA and the RG 82 First Order Network points Arbrå, Hybo and Rätansbyn.

Lagan: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a stone some kilometres south of the village Lagan. The point is relatively connected to the A10 points Kärda AA and Öjaby AA, the RG 82 First Order Network points Osby and Torup and the RG 62 point Stenbrohult 1p.

Laholm: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock some kilometres north of the town Laholm. The point is relatively connected to the A10 point Veinge AA, the RG 82 Zero Order Network point Höör B and the RG 82 First Order Network points Sävsjö and Torup.

Lansån: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock in a forest some kilometres west of the small village Lansån. The point is relatively connected to the A10 point Övertorneå AA, the RG 82 Zero Order Network point Pello NA and the RG 82 First Order Network points Hakkas and Kalix.

Lidträsk: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock about a kilometre east of the small village Lidträsk. The point is relatively connected to the FG5 point Skellefteå AA, the RG 82 Zero Order Network point Jävre NA and the RG 82 First Order Network point Lövånger.

Lindesberg: The point was first used in 1990 as an RG 82 First Order Network point and is situated on bedrock some kilometres south of the village Lindesberg. The point is relatively connected to the A10 point Ljusnarsberg AA, the RG 82 First Order Network points Bofors and Örebro and the RG 62 point Lindesberg 1p.

Lindesberg 1p: The point was first used in the 1960s as an RG 62 point and is situated on a benchmark at a step outside the entrance of Lindesberg church. The point is relatively connected to the RG 82 First Order Network points Ekshärad and Lindesberg.

Lofsdalen: The point was first used in 2001 as an RG 82 First Order Network point and is situated on a large stone, in the southwestern part of Lofsdalen (see Figure 41). The point is relatively connected to the A10 point Sveg AA, the RG 82 Zero Order Network point Älvdalen A and the RG 82 First Order Network points Idre and Tännäs.

Ludvika: The point was first used in 1990 as an RG 82 First Order Network point and is situated on bedrock a few kilometres south west of Ludvika (see Figure 50). The point is relatively connected to the A10 point Fredriksberg AA, the RG 82 First Order Network point Grythyttan and the RG 62 point Ludvika 1p.

Ludvika 1p: The point was first used in the 1960s as an RG 62 point and is not a benchmark, but is situated on the top step outside the entrance of Ludvika church. Note that it is not at the benchmark some steps further down. The point is relatively connected to the A10 point Ljusnarsberg AA and the RG 82 First Order Network point Ludvika.

Lycksele A: The point was first used in 1975 as a main point on the 65th degree land uplift gravity line and became in 1981 an RG 82 Zero Order Network main point. It is situated on bedrock in a small forest between the eastern parts of Lycksele and the railway. The point is relatively connected to the FG5 point Lycksele AA, the A10 points Bjurholm AA and Sävar AA, the RG 82 Zero Order

Network points Lycksele C and Stensele A and the RG 82 First Order Network points Fredrika, Malå and Vinliden.

Lycksele C: The point was first used in 1988 as an RG 82 Zero Order Network spare point and is situated about 100 metres from Lycksele A, to which it is relatively connected.

Lycksele D: The point was first used in 2019 as a new point and is situated on bedrock just outside the hut where the FG5 point Lycksele AA is situated. The point is relatively connected to Lycksele AA.

Lönneberga: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock next to the railway, between the villages Lönneberga and Silverdalen. The point is relatively connected to the A10 points Eksjö AA, Misterhult AA and Virserum AA and the RG 82 Zero Order Network point Västervik NA and the RG 82 First Order Network point Åseda.

Lövånger: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a large leaning piece of bedrock in the west part of the village Lövånger. The point is relatively connected to the FG5 point Ratan AA, the A10 point Bureå AA, the RG 82 Zero Order Network point Jävre NB and the RG 82 First Order Network point Lidträsk.

Malung: The point was first used in 1996 as an RG 82 First Order Network point and is situated on a large stone about six kilometres northwest of the village Malung. The point is relatively connected to the A10 points Stöllet AA and Vansbro AA, the RG 82 First Order Network point Transtrand and the RG 62 point Malung 1p.

Malung 1p: The point was first used in the 1960s as an RG 62 point and is not a benchmark, but is situated on a step outside the entrance of Malung church. The point is relatively connected to the A10 point Särna AA and the RG 82 First Order Network point Malung.

Malå: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock in the forest some kilometres northwest of the village Malå. The point is relatively connected to the A10 points Arvidsjaur AA and Norsjö AA, the RG 82 Zero Order Network point Lycksele A and the RG 82 First Order Network point Norsjö.

Mora: The point was first used in 2001 as an RG 82 First Order Network point and was situated on a large stone three kilometres north of Mora. The point was destroyed between 2001 and 2011 due to ditching along the road. The point was relatively connected to the RG 82 Zero Order Network point Älvdalen A and the RG 82 First Order Network point Rättvik.

Motala: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock some kilometres east of the town Motala. The point is relatively connected to the A10 points Ljusfallshammar AA and Norrköping AA and the RG 82 Zero Order Network point Ödeshög NA.

Mårtsbo B: The point was first used in 1975, became in 1981 an RG 82 Zero Order Network spare point. It is situated on bedrock about 100 metres west of Mårtsbo observatory. The point is relatively connected to the FG5 points Mårtsbo AA and Mårtsbo AB and the RG 62 points Skutskär 1p, Sundsvall 1p and Söderhamn 1p.

Mönsterås 1p: The point was first used in the 1960s as an RG 62 point and is not a benchmark, but is situated on a step outside the entrance of Mönsterås church. The point is relatively connected to the A10 point Gamleby AA and the RG 82 First Order Network point Blomstermåla.

Norra Ny 1p: The point was first used in the 1960s as an RG 62 point and is not a benchmark, but is situated on a step outside the entrance of Norra Ny church in Stöllet. The point is relatively connected to the A10 point Stöllet AA and the RG 82 First Order Network point Sysslebäck.

Norra Råda 1p: The point was first used in the 1960s as an RG 62 point and is not a benchmark, but is situated on a step outside the entrance of Norra Råda church. The point is relatively connected to the A10 point Stöllet AA and the RG 82 Zero Order Network point Karlstad NA.

Norrtälje: The point was first used in 2001 as an RG 82 First Order Network point and is situated on a stone about five kilometres north of the town Norrtälje. The point is relatively connected to the A10 point Norrtälje AA, the RG 82 Zero Order Network point Östhammar A and the RG 82 First Order Network point Uppsala.

Norsjö: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a large stone in the eastern part of the village Norsjö. The point is relatively connected to the A10 point Norsjö AA and the RG 82 First Order Network points Hällnäs and Malå.

Onsala A: The point was first used in 2019 and is situated at the Onsala Space Observatory area on a cylindrical block of concrete outside the hut where the FG5 points Onsala AN and AS are situated. The point is relatively connected to the FG5 point Onsala AA.

Onsala B: The point was first used in 2019 as a new point and is situated on bedrock right outside (east) of the Onsala Space Observatory area. The point is relatively connected to the FG5 point Onsala AA.

Osby: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a large stone some kilometres west of the village Osby. The point is relatively connected to the A10 point Älmhult AA, the RG 82 Zero Order Network point Höör B and the RG 82 First Order Network point Lagan.

Pajala: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a stone some kilometres south of the village Pajala. The point is relatively connected to the A10 point Tärendö AA, the RG 82 Zero Order Network point Pello NA, the RG 82 First Order Network point Junosuando and the RG 62 point Pajala 1p.

Pajala 1p: The point was first used in the 1960s as an RG 62 point and is not a benchmark, but is situated on a step outside the entrance of Pajala church. The point is relatively connected to the A10 point Karesuando AA and the RG 82 First Order Network point Pajala.

Pello 1p: The point was first used in the 1960s as an RG 62 point and is not a benchmark, but is situated on a step inside the entrance of Pello school house. It means that the point is only accessible when the school is open. The point is relatively connected to the RG 82 Zero Order Network points Pello NA and Pello NB.

Pello NA: The point was first used in 1981 as an RG 82 Zero Order Network main point and is situated on a large stone in the forest close to the very small village Neistenkangas. The point is relatively connected to the A10 point Övertorneå AA, the RG 82 Zero Order Network points Jukkasjärvi NA and Jävre NA, the RG 82 First Order Network points Lansån and Pajala and the RG 62 point Pello 1p.

Pello NB: The point was first used in 1981 as an RG 82 Zero Order Network spare point and is situated on bedrock closely north of the river Pentäsjoki. In 2011 the point was totally covered by big branches and then impossible to use if not cutting down the branches. The point is relatively connected to the RG 82 Zero Order Network point Pello NA and the RG 62 point Pello 1p.

Porjus: The point was first used in 2001 as an RG 82 First Order Network point and is situated on bedrock in the south part of the village Porjus. The point is relatively connected to the RG 82 First Order Network points Gällivare and Vittangi.

Ramsele: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a large stone in the very south of the village Ramsele. The point is relatively connected to the RG 82 First Order Network points Gulsele and Stavreviken.

Ratan B: The point was first used in 2017 as a new point and is situated on bedrock, a few metres outside the hut where the FG5 point Ratan AA is situated. The point is relatively connected to Ratan AA and the A10 point Sävar AA.

Rätansbyn: The point was first used in 2001 as an RG 82 First Order Network point and is situated on a large stone in a forest in the western part of the village Rätansbyn. The point is relatively connected to the A10 points Svenstavik AA and Överturingen AA, the RG 82 Zero Order Network point Stugun A and the RG 82 First Order Network points Hede, Järpen and Laforsen.

Rättvik: The point was first used in 2001 as an RG 82 First Order Network point and was situated on a stone in the eastern part of the village Rättvik. It was still there in 2011, but in 2015 it was found destroyed. The point was relatively connected to the RG 82 First Order Network points Borlänge and Mora.

Saxnäs: The point was first used in 1992 as an RG 82 First Order Network point and is situated on bedrock 150 metres from the hotel Saxnäsgården in Saxnäs. The point is relatively connected to the A10 points Klimpfjäll AA and Vilhelmina AA and the RG 82 First Order Network points Stekenjokk and Vilhelmina.

Skellefteå B: The point was first used in 2017 as a new point and is situated on bedrock just outside of the hut where the FG5 point Skellefteå AA is situated. The point is relatively connected to Skellefteå AA and the RG 82 Zero Order Network point Jävre NB.

Skutskär 1p: The point was first used in the 1960s as an RG 62 point and is not a benchmark, but is situated on a step outside the entrance of Skutskär church (see Figure 42). The point is relatively connected to the FG5 points LMV AA and Mårtsbo AA.

Skönberga 1p: The point was first used in the 1960s as an RG 62 point and is not a benchmark, but is situated on a step outside the entrance of Skönberga church. The point is relatively connected to the A10 point Norrköping AA.

Sollefteå: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a large stone some kilometres southeast of the town Sollefteå. The point is relatively connected to the A10 points Kramfors AB and Sollefteå AA and the RG 82 First Order Network point Junsele.

Solna: The point was first used in 1990 as an RG 82 First Order Network point and is situated on bedrock some hundred metres west of Solna church in the town Solna. The point is relatively connected to the FG5 point Mårtsbo AA, the A10 point Solna AA and the RG 82 First Order Network points Enköping and Jordbro.

Soppero: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock some kilometres from the village Övre Soppero. The point is relatively connected to the RG 82 Zero Order Network point Jukkasjärvi NA and the RG 82 First Order Network points Karesuando and Vittangi.

Sorsele: The point was first used in 2001 as an RG 82 First Order Network point and is situated on a large stone some kilometres east of the village Sorsele. The point is relatively connected to the RG 82 Zero Order Network point Stensele B and the RG 82 First Order Network point Arjeplog.

Stavre: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a large stone outside a house in the small village Stavre. The point is relatively connected to the RG 82 Zero Order Network point Stugun A and the RG 82 First Order Network point Alby.

Stavreviken: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a large stone about two kilometres southeast of the village Stavreviken. The point is relatively connected to the A10 points Junsele AA, Kramfors AB and Sundsvall AA and the RG 82 First Order Network point Ramsele.

Stekenjokk: The point was first used in 1992 as an RG 82 First Order Network point and is situated on bedrock some kilometres south of the abandoned mine Stekenjokk and south of the county border (see Figure 50). The point is relatively connected to the A10 points Klimpfjäll AA and Sved AA and the RG 82 First Order Network point Saxnäs.

Stenbrohult 1p: The point was first used in the 1960s as an RG 62 point and is not a benchmark, but is situated on a step outside the entrance of Stenbrohult church. The point is relatively connected to the A10 point Älmhult AA and the RG 82 First Order Network point Lagan.

Stensele A: The point was first used in 1975 in the 65th degree land uplift gravity line and became in 1981 an RG 82 Zero Order Network main point. It is situated on bedrock on the west side of the railway in the west part of the village Gunnarn. Since the railway must be crossed by foot to reach the point, this point is not recommended. Instead, we recommend Stensele AA (some fifthteen kilometres away) or Stensele B (some ten kilometres away). The point is relatively connected to the A10 points Kåbdalis AA and Vilhelmina AA, the RG 82 Zero Order Network points Föllinge A, Lycksele A, Stensele B and Umbukta A, the RG 82 First Order Network points Vilhelmina and Vinliden and the RG 62 point Stensele B 1p.

Stensele B: The point was first used in 1975 in the 65th degree land uplift gravity line and became in 1981 an RG 82 Zero Order Network spare point. It is situated on bedrock on a mountain close to the small village Barsele (see Figure 42). The way from the parking place to the point is steep and could be slippery, thus the point Stensele AA is recommended. The point is relatively connected to the A10 points Stensele AA and Sorsele AA, the RG 82 First Order Network points Jäkkvik, Sorsele, Strömsund and Tärnaby and the RG 62 point Stensele B 1p.

Stensele B 1p: The point was first used in the 1970s as a spare point to the RG 62 point Stensele A 1p (situated on the lid to a well) and is not a benchmark, but is situated on a step outside the western entrance of Stensele church, the largest wooden church in Sweden. At the southern entrance the A10 point Stensele AA is situated. The point is relatively connected to the RG 82 Zero Order Network points Stensele A and Stensele B.

Stora Tuna 1p: The point was first used in the 1960s as an RG 62 point and is not a benchmark, but is situated on a step outside the entrance of Stora Tuna church. The point is relatively connected to the RG 82 First Order Network point Borlänge.

Ström 1p: The point was first used in the 1960s as an RG 62 point and is not a benchmark, but is situated on a step outside the entrance of Ström church in the village Strömsund in Jämtland. During the second A10 campaign, it was planned to be observed with the A10, but when trying it was found out that the step was too weak leading to large residuals. The point is relatively connected to the A10 point Sved AA, the RG 82 Zero Order Network point Föllinge A and the RG 82 First Order Network point Hoting.

Strömsund: The point was first used in 2001 as an RG 82 First Order Network point and is situated on a large stone in the north part of the small village Strömsund in Lappland. The point is relatively connected to the A10 point Stensele AA, the RG 82 Zero Order Network point Stensele B and the RG 82 First Order Network point Tärnaby.

Stugun A: The point was first used in 1967 in the 63rd degree land uplift gravity line and became in 1981 an RG 82 First Order Network spare point. It is situated on a large stone some kilometres south west of the village Stugun. The point is relatively connected to the A10 points Ragunda AA, Stugun AA and Svenstavik AA, the RG 82 Zero Order Network point Stugun B and the RG 82 First Order Network points Boda, Järpen, Krokom, Rätansbyn and Stavre.

Stugun B: The point was first used in 1967 in the 63rd degree land uplift gravity line and became in 1981 an RG 82 First Order Network main point. It is situated on bedrock in a forest a couple of hundred metres east of Stugun A. The point is relatively connected to the A10 points Kramfors AB and Östersund AB and the RG 82 Zero Order Network points Föllinge A, Stugun A, Stugun C and Stugun D.

Stugun C: The point was first used in 1967 in the 63rd degree land uplift gravity line and became in 1981 an RG 82 First Order Network spare point. It is situated on bedrock a couple of hundred metres south of Stugun A. The point is relatively connected to the RG 82 Zero Order Network point Stugun B.

Stugun D: The point was first used in 1972 in the 63rd degree land uplift gravity line and became in 1981 an RG 82 First Order Network spare point. It is situated on bedrock a couple of hundred metres south of Stugun A. The point is relatively connected to the RG 82 Zero Order Network point Stugun B.

Sundsvall 1p: The point was first used in the 1960s as an RG 62 point and is not a benchmark, but is situated in a recess outside the entrance of Gustaf Adolf church in Sundsvall, about 10 metres north of the A10 point Sundsvall AA to which it is relatively connected.

Sveg: The point was first used in 2001 as an RG 82 First Order Network point and is situated on a large stone about three kilometres southwest of the village Sveg. The point is relatively connected to the A10 points Hede AA and Sveg AA and the RG 82 First Order Network points Hede and Tandsjöborg.

Svenljunga: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a very large stone some five kilometres south of the village Svenljunga. The point is relatively connected to the FG5 point Borås AA, the A10 point Kärda AA and the RG 82 First Order Network points Borås and Veddige.

Sysslebäck: The point was first used in 1996 as an RG 82 First Order Network point and is situated on bedrock in the village Sysslebäck. The point is relatively connected to the A10 point Stöllet AA and the RG 62 point Norra Ny 1p.

Särna: The point was first used in 2001 as an RG 82 First Order Network point and is situated on bedrock some five kilometres northwest of the village Särna. The point is relatively connected to the RG 82 Zero Order Network point Älvdalen A and the RG 82 First Order Network point Idre.

Särna 1p: The point was first used in the 1960s as an RG 62 point and is not a benchmark, but is situated on a step outside the entrance of Särna new church. It was planned to be observed during the fourth A10 campaign, but the step was too weak for the A10. The point is relatively connected to the A10 point Särna AA.

Sävar B: The point was first used in 1975 in the 65th degree land uplift gravity line and became in 1981 an RG 82 Zero Order Network spare point. It is situated on bedrock a couple of hundred metres north of the A10 point Sävar AA. The point is relatively connected to Sävar AA.

Sävsjö: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a large stone directly south of the village Sävsjö. The point is relatively connected to the A10 points Eksjö AA and Veinge AA and the RG 82 First Order Network points Aneby, Laholm and Ör.

Söderhamn 1p: The point was first used in the 1960s as an RG 62 point and is not a benchmark, but is situated on a step outside the entrance of Söderhamn church. The point is relatively connected to the A10 point Bollnäs AA and the RG 82 First Order Network point Vallvik.

Södertälje NA: The point was first used in 1981 as an RG 82 Zero Order Network main point and is situated on bedrock close to the manor house Sundsör, some kilometres north of Turinge church. The point is relatively connected to the A10 points Nyköping AA, Tullinge AA and Valla AA, the RG 82 Zero Order Network points Karlstad NA, Visby NA, Västervik NA and Östhammar A, the RG 82 First Order Network points Enköping, Eskilstuna and Jordbro and the RG 62 point Turinge 1p.

Södertälje NB: The point was first used in 1984 as an RG 82 Zero Order Network spare point and is situated on bedrock, some kilometres north of Södertälje NA. These two points are relatively connected.

Södra Fågelås 1p: The point was first used in the 1960s as an RG 62 point and is not a benchmark, but is situated on a step outside the entrance of Södra Fågelås church. The point is relatively connected to the RG 82 First Order Network point Dala.

Sölvesborg A: The point was first used in 1977 in the 56th degree land uplift gravity line and became in 1981 an RG 82 First Order Network main point. It is situated on bedrock in Ryssbergen. The point is relatively connected to the A10 point Sölvesborg AA, the RG 82 Zero Order Network points Höör A, Höör B and Västervik NA and the RG 82 First Order Network points Johannishus and Urshult. In order to get to the closest possible parking place, a key to a gate is needed if one wants to avoid walking some 500 metres. The key can be found at Trolle-Ljungby estate.

Sölvesborg B: The point was first used in 1977 in the 56th degree land uplift gravity line and became in 1981 an RG 82 First Order Network spare point. It is situated on bedrock some hundred metres north east of Sölvesborg A and these two points are relatively connected.

Tandsjöborg: The point was first used in 2001 as an RG 82 First Order Network point and is situated on a stone one kilometer south of the Tandsjöborg railway station. The point is relatively connected to the RG 82 Zero Order Network point Älvdalen A and the RG 82 First Order Network point Sveg.

Tanum: The point was first used in 1985 as an RG 82 First Order Network point and is situated on bedrock some kilometres west of the village Tanum and about 100 metres from some rock carvings. The point is relatively connected to the RG 82 First Order Network points Dals Ed and Uddevalla.

Tingstäde 1p: The point was first used in 197X as one of seven points on Gotland measured by Lennart Pettersson. In 1984 it was observed again and became an RG 82 First Order Network point. First the day before this report was finished, the point description was found in a protocol book. The point is relatively connected to the RG 82 Zero Order Network point Visby NA and the RG 82 First Order Network point Bunge.

Torneträsk: The point was first used in 2001 as an RG 82 First Order Network point and is situated on a large stone, north of the small village Torneträsk. The point is relatively connected to the RG 82 Zero Order Network points Jukkasjärvi NA and Björkliden NB and the RG 82 First Order Network point Vittangi.

Torpshammar: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a large stone about two kilometres north of the village Torpshammar. The point is relatively connected to the A10 points Borgsjö AA and Sundsvall AA and the RG 82 First Order Network points Alby and Boda.

Torsby: The point was used in 1985 as an RG 82 First Order Network point and was situated on bedrock some kilometres west of the village Torsby. It was destroyed in the 1990s when the road was widened. The point was relatively connected to the A10 point Säffle AA and the RG 82 First Order Network point Ekshärad.

Torsås: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock some kilometres from the village Torsås. The point is relatively connected to the A10 point Emmaboda AA, the RG 82 Zero Order Network point Västervik NA and the RG 82 First Order Network point Borgholm.

Torup: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock one kilometre west of the village Torup. The point is relatively connected to the A10 points Falkenberg AA and Kärda AA and the RG 82 First Order Network points Lagan and Laholm.

Transtrand: The point was first used in 1996 as an RG 82 First Order Network point and is situated on bedrock in the eastern part of the small village Transtrand. The point is relatively connected to the A10 point Transtrand AA, the RG 82 Zero Order Network point Älvdalen A and the RG 82 First Order Network point Malung.

Turinge 1p: The point was first used in the 1960s as an RG 62 point and is not a benchmark, but is situated on a step outside the entrance of Turinge church. The point is relatively connected to the RG 82 Zero Order Network point Södertälje NA.

Tännäs: The point was first used in 2001 as an RG 82 First Order Network point and is situated on bedrock in the east part of the village Tännäs. The point is relatively connected to the A10 point Hede AA, the RG 82 Zero Order Network point Älvdalen A and the RG 82 First Order Network points Hede and Lofsdalen.

Tärnaby: The point was first used in 2001 as an RG 82 First Order Network point and is situated on bedrock, next to the church. The point is relatively connected to the A10 point Umbukta AA, the RG 82 Zero Order Network point Stensele B and the RG 82 First Order Network points Hemavan and Strömsund.

Tärnsjö: The point was first used in 2001 as an RG 82 First Order Network point and is situated on a stone in the central part of the village Tärnsjö. The point is relatively connected to the FG5 point LMV AA, the A10 point Grytnäs AA and the RG 82 First Order Network points Avesta and Uppsala.

Uddevalla: The point was first used in 1985 as an RG 82 First Order Network point and is situated on bedrock in the north part of the town Uddevalla. The point is relatively connected to the FG5 point Smögen AA, the A10 point Klöveskog AA, the RG 82 Zero Order Network point Göteborg NB and the RG 82 First Order Network points Dals Ed and Tanum.

Umbukta A: The point was first used in 1975 in the 65th degree land uplift gravity line and became in 1981 an RG 82 First Order Network main point. It is situated on bedrock about three kilometres from the Norwegian border. The point is relatively connected to the A10 point Umbukta AA, the RG 82 Zero Order Network points Stensele A and Umbukta B and the RG 82 First Order Network point Hemavan.

Umbukta B: The point was first used in 1975 in the 65th degree land uplift gravity line and became in 1981 an RG 82 First Order Network spare point. It is situated on bedrock about 100 metres from the RG 82 Zero Order Network point Umbukta A. The point is relatively connected to Umbukta A.

Uppsala: The point was first used in 2001 as an RG 82 First Order Network point and is situated on bedrock, close to the astronomical observatory. The point is relatively connected to the FG5 points LMV AA and Mårtsbo AA, the A10 point Husby-Ärlinghundra AA, the RG 82 First Order Network points Avesta, Norrtälje and Tärnsjö and the RG 62 point Uppsala C 1p.

Uppsala C 1p: The point was first used in the 1960s as an RG 62 point and is not a benchmark, but is situated on a top step outside the entrance of the astronomical observatory in Uppsala. The point is relatively connected to the RG 82 First Order Network point Uppsala.

Urshult: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a large stone, some kilometres west of the village Urshult. The point is relatively connected to the A10 point Emmaboda AA and the RG 82 Zero Order Network point Sölvesborg A.

Vallvik: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a large stone some kilometres southwest of the village Vallvik. The point is relatively connected to the FG5 points LMV AA and Mårtsbo AA, the A10 points Boda Bruk AA and Bollnäs AA, the RG 82 First Order Network point Gnarp and the RG 62 point Söderhamn 1p.

Varberg Appelviksåsen A 1p: The point was first used in the 1960s as an RG 62 point and is not a benchmark, but is situated on a concrete pillar on a hill in the south part of the town Varberg. The point is relatively connected to the FG5 point Onsala AA, the A10 point Veinge AA and the RG 82 First Order Network point Veddige.

Veddige: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock some kilometres west of the small village Veddige (see

Figure 48). The point is relatively connected to the FG5 point Onsala AA, the A10 point Falkenberg AA, the RG 82 Zero Order Network point Göteborg NB, the RG 82 First Order Network points Borås and Svenljunga and the RG 62 point Varberg 1p.

Vilhelmina: The point was first used in 1992 as an RG 82 First Order Network point and is situated on bedrock some kilometres northwest of the village Vilhelmina. The point is relatively connected to the A10 point Vilhelmina AA, the RG 82 Zero Order Network point Stensele A and the RG 82 First Order Network points Saxnäs, Vinliden and Åsele.

Vinliden: The point was first used in 1992 as an RG 82 First Order Network point and is situated on bedrock close to the small village Vinliden. The point is relatively connected to the A10 point Vilhelmina AA, the RG 82 Zero Order Network points Lycksele A and Stensele A and the RG 82 First Order Network point Vilhelmina.

Visby D: The point was first used in 2017 as a new point and is a benchmark included in the local network for monitoring the SWEPOS pillar. It is situated on bedrock a few metres from Visby AA. The point is relatively connected to the FG5 point Visby AA.

Visby NA: The point was first used in 1981 as an RG 82 Zero Order Network main point and is situated on bedrock some four kilometres north of the town Visby (see Figure 46). The point is relatively connected to the FG5 point Visby AA, the RG 82 Zero Order Network points Södertälje NA, Visby NB and Västervik NA and the RG 82 First Order Network points Bunge, Gothem, Grötlingbo and Tingstäde 1p.

Visby NB: The point was first used in 1984 as an RG 82 Zero Order Network spare point and is situated on bedrock one kilometer south of Visby NA. Note that this point has not been found after 1998. The point is relatively connected to the RG 82 Zero Order Network point Visby NA and the RG 82 First Order Network point Garde.

Vittangi: The point was first used in 2001 as an RG 82 First Order Network point and is situated on bedrock some kilometres west of the village Vittangi. The point is relatively connected to the RG 82 Zero Order Network point Jukkasjärvi NA, the RG 82 First Order Network points Junosuando, Porjus, Soppero and Torneträsk, the RG 62 point Vittangi 1p and the new point Vittangi 2p.

Voxna: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock about a kilometre west of the village Voxna (not to be mixed up with Voxna bruk, where Voxna AA is situated). The point is relatively connected to the FG5 point Mårtsbo AA, the A10 point Voxna AA and the RG 82 First Order Network point Åmot.

Västervik NA: The point was first used in 1981 as an RG 82 Zero Order Network main point and is situated on bedrock less than 200 metres southwest of the manor house Blekhem. The point is relatively connected to the A10 points Gamleby AA and Misterhult AA, the RG 82 Zero Order Network points Södertälje NA, Sölvesborg A, Visby NA, Västervik NB and Ödeshög NA and the RG 82 First Order Network points Kastlösa, Lönneberga and Torsås.

Västervik NB: The point was first used in 1984 as an RG 82 Zero Order Network spare point and is situated on bedrock some five kilometres east of Västervik NA. Note that the point has not been found after 1984. The point is relatively connected only to the RG 82 Zero Order Network point Västervik NB.

Åmot: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a large stone a couple of kilometres north of the small village Åmot. The point is relatively connected to the FG5 points LMV AA and Mårtsbo AA and the RG 82 First Order Network point Voxna.

Ånn: The point was first used in 2001 as an RG 82 First Order Network point and is situated on bedrock very close to a small stream some kilometres west of the small village Ånn. The point is relatively connected to the A10 point Duved AA and the RG 82 First Order Network points Järpen and Krokom.

Åseda: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock some kilometres east of the village Åseda. The point is relatively connected to the A10 points Falkenberg AA and Virserum AA and the RG 82 First Order Network points Blomstermåla and Lönneberga.

Åsele: The point was first used in 1992 as an RG 82 First Order Network point and is situated on bedrock some kilometres north of the village Åsele. The point is relatively connected to the RG 82 First Order Network points Fredrika and Vilhelmina and the RG 62 point Granberget 1p.

Åstorp: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock with a view towards the railway station in Åstorp. The point is relatively connected to the A10 points Helsingborg AA and Simrishamn AA, the RG 82 Zero Order Network point Höör B and the RG 82 First Order Network point Dalby.

Åte: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock about ten kilometres southwest of the town Örnsköldsvik. The point is relatively connected to the A10 point Kramfors AB and the RG 82 First Order Network point Björna.

Åtvidaberg: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock in the central part of the village Åtvidaberg. The point is relatively connected to the A10 points Gamleby AA, Ljusfallshammar AA and Rimforsa AA and the RG 82 First Order Network point Kisa.

Älvdalen A: The point was first used in 1976 in the 61st degree land uplift gravity line and became in 1981 an RG 82 First Order Network main point. It is situated on bedrock some 10 kilometres north of the village Älvdalen. The point is relatively connected to the A10 points Vansbro AA and Älvdalen AA, the RG 82 Zero Order Network points Föllinge A, Hofors A, Karlstad NA and Älvdalen B and the RG 82 First Order Network points Lofsdalen, Mora, Särna, Tandsjöborg, Transtrand and Tännäs.

Älvdalen B: The point was first used in 1976 in the 61st degree land uplift gravity line and became in 1981 an RG 82 First Order Network spare point. It is situated on bedrock about a kilometre north of Älvdalen A. The point is situated very unfavourably, thus it is recommended to use either Älvdalen A or Älvdalen AA. The point is relatively connected only to the RG 82 Zero Order Network point Älvdalen A.

Älvsbyn: The point was first used in 2002 as an RG 82 First Order Network point and is situated on a large stone some kilometres east of the village Älvsbyn. The point is relatively connected to the A10 point Älvsbyn AA, the RG 82 Zero Order Network point Jävre NB and the RG 82 First Order Network point Edefors.

Ödeshög NA: The point was first used in 1981 as an RG 82 Zero Order Network main point and is situated on bedrock about one kilometre south of the village Ödeshög. The point is relatively connected to the A10 points Norrköping AA and Västra Tollstad AA, the RG 82 Zero Order Network points Göteborg NB and Västervik NA, the RG 82 First Order Network points Aneby, Bottnaryd, Dala, Hillerstorp, Kisa and Motala and the RG 62 point Jönköping 1p.

Ödeshög NB: The point was first used in 1984 as an RG 82 Zero Order Network spare point and is situated on bedrock about a kilometre south of the RG 82 Zero Order Network point Ödeshög NA. The point is relatively connected only to Ödeshög NA.

Ör: The point was first used in 2002 as an RG 82 First Order Network point and is situated on bedrock some kilometres east of the village Ör. The point is relatively connected to the A10 point Öjaby AA and the RG 82 First Order Network points Hillerstorp and Sävsjö.

Örebro: The point was first used in 1990 as an RG 82 First Order Network point and is situated on bedrock in a wood in the Örebro suburb Adolfsberg. The point is relatively connected to the A10 points Arboga AA, Laxå AA and Ljusfallshammar AA, the RG 82 First Order Network points Bofors and Lindesberg and the RG 62 point Örebro 1p.

Örebro 1p: The point was first used in the 1960s as an RG 62 point and is bolt in a paving stone outside Örebro castle. The point is relatively connected to the RG 82 First Order Network point Örebro.

Östhammar A: The point was first used in 1976 in the 61st degree land uplift gravity line and became in 1981 an RG 82 First Order Network main point. It is situated on bedrock some five kilometres north of the town Östhammar. The point is relatively connected to the A10 point Öregrund AA,

Östhammar B: The point was first used in 1976 in the 61st degree land uplift gravity line and became in 1981 an RG 82 First Order Network spare point. It is situated on bedrock some four kilometres west of Östhammar A. The point is relatively connected only to the RG 82 Zero Order Network point Östhammar A.

Övertorneå 1p: The point was first used in the 1960s as an RG 62 point and is not a benchmark, but is situated on a step outside the entrance of Övertorneå church. The point is relatively connected to the A10 point Övertorneå AA.

Helsingør R: The point was first used in 197X in the 56^{th} degree land uplift gravity line. It is situated at the first floor in a school building in the Danish town Helsingør. The point is relatively connected to the RG 82 Zero Order Network point Höör B.

8 Software for adjustment

As the software used for RG 82 is not available anymore and a market check did not show any suitable software that fulfilled our requirements, we decided to develop a new software in which we used the same observation equations and adjustment theory as in our old RG 82 software *(Persson 1982)*. The software contains three parts, Gprep, Gad and Gcross, which are presented in the following Sections. The code was written in Fortran by Henrik Bryskhe.

8.1 Gprep

Gprep prepares the relative data from different instruments and several input files to two input files for Gad in the land uplift epoch 2000.0. One of the input files to Gad includes all relative observations and the other includes precomputed differences, which in this case means observations where we only have the result (the "known" difference) and no relative observations. The software is started from the Windows command-line.

There are two kind of input files with relative observations, based on which kind of relative gravimeter they came from, one for LCR observations and one for Scintrex observations. For precomputed differences there is only one kind of input file.

8.1.1 Gred2, for LCR observations

When observing with an LCR gravimeter, after levelling the instrument, you turn a wheel until an equilibrium is obtained inside the gravimeter. When looking into the ocular of the instrument, a line should be in a certain position. Then you read five numbers on the gravimeter and the two remaining numbers you read from the wheel. These numbers are not equivalent to µGal and differ from instrument to instrument. Every instrument got its own unique manual where the conversion table to µGal for that specific instrument can be found. It is possible to count all of this by hand when using this table, but it is of course much easier to use a software. For this we have used the software Gred2, written by Jaakko Mäkinen (FGI). The software is also adding or subtracting the influence of the height, pressure, temperature, vertical gradient and making tidal corrections. A configuration input file (including the calibration factor, how much the specific instrument is influenced by pressure and temperature etc) must be prepared before the software is used. A file with input polar coordinates is read only if the configuration input file says such a file should be used. The resulting LST-file is the input file to Gprep. Note that this software uses the program PFGI 85 by Markku Heikkinen (FGI) for tidal corrections, but in Gprep these tidal corrections are replaced by ETGTAB (see *Timmen, Wenzel 1995).*

Below is an example of an output file from Gred2 with the .LST extension, which is the input file to Gprep. There is no limit on how many such files Gprep can use. This actual file is much longer, only the interesting lines are included here:

```
*              REDUCTION OF GRAVITY OBSERVATIONS
```

* RGmätn, obs Andreas Engfeldt

* INSTRUMENT IDENTIFICATION <G54 >

* UNIT IS ONE MICROCAL OR NEAREST EQUIVALENT.

* THE FOLLOWING METHODS ARE USED:

* THE CALIBRATION TABLE OF THE GRAVIMETER

* ADDITIONAL SCALE FACTOR 1.000750

* A VERSION OF THE PROGRAM BY M.HEIKKINEN (PFGI 85) IS USED FOR THE TIDAL CORRECTION, *

* THE STATIONARY TIDE IS TREATED ACCORDING TO THE 1983 RESOLUTION,

THE OBSERVATIONS

KEY:

1 STATION

2...7 DATE (YEAR,MONTH,DAY,HOUR,MINUTE,SECOND). DATE - UT = 0 H, ET - UT = 0 SECONDS

8 HEIGHT OF THE REFERENCE POINT IN THE GRAVIMETER ABOVE THE STATION REFERENCE (CM)

9 PRESSURE (MBAR)

10 OUTER TEMPERATURE (C)

11 GRAVIMETER READING - 4893000.0

12 COLUMN 11 CONVERTED TO MICROGALS

13 TIDAL CORRECTION

14 CORRECTION FOR THE POLAR MOTION

15 CORRECTION FOR THE VERTICAL GRADIENT

16 CORRECTION FOR THE GRAVITATIONAL FORCE OF THE ATMOSPHERE

17 INSTRUMENTAL PRESSURE CORRECTION

18 INSTRUMENTAL TEMPERATURE CORRECTION

19 SUM OF THE COLUMNS 12 TO 18

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
SFa1p	2016	8	29	6	38.	0	29.8	990.6	18.0	32478.0	33998.7	13.7	-1.9	42.9	-2.6	-.5	1.2	34051.6
Dalaa	2016	8	29	7	30.	0	27.6	985.9	20.0	46873.0	49067.5	31.6	-2.0	36.1	-2.6	-.7	2.0	49131.9
BalAA	2016	8	29	8	7.	0	30.0	984.8	20.0	32531.0	34054.2	42.0	-2.0	44.9	-2.6	-.8	2.0	34137.8
Bottn	2016	8	29	9	26.	0	28.2	980.3	20.0	833.0	872.1	51.4	-2.0	38.0	-5.3	-1.0	2.0	955.1
UlrAA	2016	8	29	10	14.	0	29.9	983.7	18.0	10090.0	10562.9	46.3	-2.0	44.5	-2.3	-.8	1.2	10649.7
UlrAA	2016	8	29	10	21.	0	29.9	984.0	18.0	10090.0	10562.9	45.0	-2.0	44.5	-2.2	-.8	1.2	10648.5
Bottn	2016	8	29	11	27.	0	28.2	981.3	18.0	859.0	899.3	25.1	-2.0	38.0	-5.0	-.9	1.2	955.6

BalAA 2016 8 29 12 32. 0 29.9 987.5 18.0 32577.0 34102.4 -3.6 -2.0 44.6 -1.8 -.6 1.2 34140.2

Dalaa 2016 8 29 13 13. 0 27.3 989.4 18.0 46924.0 49120.9 -22.3 -2.0 35.2 -1.6 -.5 1.2 49130.9

SFa1p 2016 8 29 14 12. 0 29.5 993.4 17.5 32538.0 34061.6 -48.3 -1.9 42.0 -1.8 -.3 1.0 34052.2

8.1.2 LMV Det g, for Scintrex observations

When observing with a Scintrex, after levelling the instrument measures by itself. The result is in µGal and no conversion is needed. However, you still have to make tidal corrections and add or subtract the influence of the height, pressure, temperature and vertical gradient. We used the software LMV_Det_g written by Jonas Ågren for this purpose. Everything the software should do is instructed in a few files which the user has to prepare. Note that today the software is updated. Also note that this software uses ETGTAB (*Timmen, Wenzel 1995*) for the tidal corrections.

Below is an example of an output file from LMV_Det_g, which is the input file to Gprep. The filename has the extension .res and there is no limit of how many such files Gprep can use. This file is much longer, only the interesting lines are included here:

title_string: 20170928, CG5_1184, Andreas Engfeldt

-- ----------------------------------

Preprocessing of observations in the cg5-file

Number of observations (groups of 60 secs obs): 7

ID Date UTC SNT JD dh_obs Offset Sensor Grad Pressure

1 KloAA 2017 9 28 9 29 52 11 29 52 2458024.895743 0.439 -0.185 0.254 -0.3401 1028.9

2 Uddev 2017 9 28 11 2 34 13 2 34 2458024.960118 0.432 -0.185 0.247 -0.3086 1031.1

3 SmoAA 2017 9 28 12 10 55 14 10 55 2458025.007583 0.439 -0.185 0.254 -0.3340 1034.2

4 SmoAA 2017 9 28 12 31 42 14 31 42 2458025.022016 0.439 -0.185 0.254 -0.3340 1034.0

5 Uddev 2017 9 28 13 46 56 15 46 56 2458025.074262 0.432 -0.185 0.247 -0.3086 1029.9

6 KloAA 2017 9 28 15 12 3 17 12 3 2458025.133370 0.438 -0.185 0.253 -0.3401 1027.4

ID NR_60s g_mean SD_mean TideCG5 g_nocorr ETGTAB Baro Sensor g_corr_mean Std Min Max
Std_mean SD_mean

1 KloAA 5 5737.211 0.029 -0.023 5737.234 -0.018 0.007 0.086 * 5737.309 * 0.001 5737.308 5737.310 0.000 0.002

2 Uddev 5 5726.863 0.031 -0.044 5726.906 -0.039 0.007 0.076 * 5726.951 * 0.001 5726.950 5726.951 0.000 0.002

3 SmoAA 5 5736.840 0.036 -0.058 5736.897 -0.052 0.006 0.085 * 5736.936 * 0.001 5736.936 5736.937 0.000 0.002

4 SmoAA 5 5736.840 0.032 -0.061 5736.902 -0.056 0.006 0.085 * 5736.937 * 0.001 5736.936 5736.938 0.000 0.002

5 Uddev 5 5726.864 0.027 -0.072 5726.936 -0.066 0.006 0.076 * 5726.952 * 0.000 5726.951 5726.952 0.000 0.002

6 KloAA 5 5737.215 0.027 -0.078 5737.293 -0.072 0.007 0.086 * 5737.313 * 0.001 5737.313 5737.315 0.000 0.002

ID Latitude Longitude Ell.height Height From file (Warning if from cg5)

1 KloAA 58.64455556 12.61563889 100.906 67.300 llh

2 Uddev 58.35691667 11.88477778 72.873 37.765 llh

3 SmoAA 58.35350000 11.21800000 41.880 5.789 llh

4 SmoAA 58.35350000 11.21800000 41.880 5.789 llh

5 Uddev 58.35691667 11.88477778 72.873 37.765 llh

6 KloAA 58.64455556 12.61563889 100.906 67.300 llh

Corrected observations and residuals

Residuals only computed in known points (F)

and in unknown points observed more than once

Fix # ID Date UTC Obs Shift Drift Obs+sh(+dr) Known/Est g Residual

F-> 1 KloAA 2017 9 28 9 29 5737.309 -5737.312 0.002 0.000 0.000 0.000 mGal

2 Uddev 2017 9 28 11 2 5726.951 -5737.312 0.001 -10.360 -10.360 0.000 mGal

3 SmoAA 2017 9 28 12 10 5736.936 -5737.312 0.001 -0.375 -0.375 0.000 mGal

4 SmoAA 2017 9 28 12 31 5736.937 -5737.312 0.000 -0.374 -0.375 0.000 mGal

5 Uddev 2017 9 28 13 46 5726.952 -5737.312 0.000 -10.360 -10.360 0.000 mGal

F-> 6 KloAA 2017 9 28 15 12 5737.313 -5737.312 -0.001 0.000 0.000 0.000 mGal

----

8.1.3 Input file for precomputed differences

The input file for precomputed differences is called "PreComputedDifferences.gprep". For Gprep there can only be one such per run. It has to be typed in accordance to the example below:

! Precomputed differences

! Instrument, epoch, from, to, difference

Instrument; G54

Epoch; 1975.7

/

UmbuA; StenA; 0.0010

StenA; LyckA; 0.0583

LyckA; SavAA; 0.0377

SavAA; SavaB; 0.0295

/

Instrument; G290

Epoch; 1975.7

```
/
  UmbuA; StenA; -0.0091
  StenA; LyckA;  0.0589
  LyckA; SavAA;  0.0695
  SavAA; SavaB;  0.0314
/
Instrument; G54
Epoch; 1980.7
/
  UmbuA; StenA;  0.0031
  StenA; LyckA;  0.0609
  LyckA; SavAA;  0.0369
/
Instrument; G290
Epoch; 1980.7
/
  UmbuA; StenA;  0.0074
  StenA; LyckA;  0.0664
  LyckA; SavAA;  0.0530
/
```

8.1.4 Input files for coordinates

There is a special input file for the coordinates, which is called “Tyngdkraftspunkter.csv”. This input file is used both by Gprep and by Gad. It must be typed in accordance to the example below:

```
Namn;Förkortning;Latitud;Longitud;Höjd;Närmevärde;Fi(x)ed;Höjdbestmetod;;;;
Björkliden NB;BjoNB;68 26 35.8;18 36 16.4;377.787;982365.528;;RTK Fixlösning;;;;
Pello NA;PelNA;66 47 49.8;23 53 35.7;93.209;982362.436;;Avvägd;;;;
Gällivare AA;GalAA;67 07 56.0;20 39 34.1;365.483;982341.1717;x;RTK Fixlösning;;;;
```

8.2 Gad, input files

Gad is the main software and makes the least squares adjustment.

The input files for Gad are the two output files from Gprep (see Subsection 8.2.2 and Subsection 8.2.3), a file with the absolute gravity data (see Subsection 8.2.1), a file with the coordinates (see Subsection 8.1.4) and a file with the instruments (see Subsection 8.2.4).

8.2.1 Input file for absolute gravity data

There is a special input file for the absolute gravity data, which is called "AbsoluteMeasures.csv". It must be typed in accordance to the example below, and all values have to be in the right epoch:

```
Total number of measures;110

StandardDeviation;0.005

/

KirAA;982337.1857;FG5;0.001

GalAA;982341.1717;A10

TarAA;982387.1341;A10

KsuAA;982428.1761;A10

OveAA;982326.8549;A10

ArvAA;982216.6108;A10

KabAA;982270.3929;A10

LulAA;982295.4764;A10

AlbAA;982302.2773;A10

HapAA;982326.9122;A10

SkeAA;982230.3968;FG5;0.001
```

8.2.2 Input file for relative gravity data

There is a special input file for the relative gravity data, which is called "relative.gad". This is also the output file from Gprep (see Subsection 8.1.1 and Subsection 8.1.2). The file must look in accordance to the example below:

```
! Output file from Gprep that also serves as input file for Gad and

! contains the relative measures in Epoch 2000


  Total number of measures;  4028

    Res number of measures;  1046

    Lst number of measures;  2982


! First all the Res measures Instrument;

CG5_1184

DriftParameter

StandardDeviation; 0.007

/
```

KloAA; 2017 9 28; 09 29;   5737.3219

Uddev; 2017 9 28; 11 02;   5726.9622

SmoAA; 2017 9 28; 12 10;   5736.9463

SmoAA; 2017 9 28; 12 31;   5736.9473

Uddev; 2017 9 28; 13 46;   5726.9632

KloAA; 2017 9 28; 15 12;   5737.3259

/

Instrument; CG5_1184

DriftParameter

StandardDeviation; 0.005

/

LMVAA; 2017 10 11; 07 13;   5901.6377

Sku1p; 2017 10 11; 08 08;   5901.0366

Sku1p; 2017 10 11; 08 37;   5901.0396

LMVAA; 2017 10 11; 09 25;   5901.6407

/

! Next all the Lst measures

Instrument; G290

DriftParameter

StandardDeviation; 0.011

/

SodNA; 1981 5 23; 08 00;   109.8675

OsthA; 1981 5 23; 11 14;   189.9348

OsthA; 1981 5 23; 13 12;   189.9477

SodNA; 1981 5 23; 16 41;   109.8605

/

Instrument; G54

DriftParameter

StandardDeviation; 0.009

/

MarAA; 1981 6 23; 11 09;   15.4805

HofoA; 1981 6 23; 12 39;   0.2118

HofoA; 1981 6 23; 13 20;   0.2141

MarAA; 1981 6 23; 14 33; 15.4819

/

8.2.3 Input file for precomputed differences

There is a special input file for the precomputed differences, which is called "PreComputedDifference.gad". This is also the output file from Gprep (see Subsection 8.1.3). The file must be look in accordance to the example below:

Instrument; G54

StandardDeviation; 0.009

/

UmbuA; StenA; 0.0137

StenA; LyckA; 0.0609

LyckA; SavAA; 0.0385

SavAA; SavaB; 0.0295

/

Instrument; G290

StandardDeviation; 0.009

/

UmbuA; StenA; 0.0036

StenA; LyckA; 0.0615

SavAA; SavaB; 0.0314

/

8.2.4 Input file for instruments

There is a special input file for the instruments, which is called "Instruments.csv". It must be typed in accordance to the example below:

Number of instruments; 16

Number of absolute instruments; 3

Number of relative instruments; 13

! ==================================

AbsoluteInstruments

Instrument; FG5-233

/

Instrument; FG5-220

/

Instrument; A10-020

/

! ==================================

RelativeInstruments

Instrument; G54

/

Instrument; G290

/

Instrument; G54X

/

Instrument; CG5_1184

/

Instrument; CG5_740

/

Instrument; CG5_198

ScaleCorrectionFixed; 1.000000

/

Instrument; GNordic

ScaleCorrectionFixed; 1.000000

/

8.3 Gad, formulas used

Gad is the main software and makes the least squares adjustment. The input files are described in Section 8.2.

8.3.1 Formulas for absolute gravity data

Absolute observation i of gravity point j,

$$l_i - \varepsilon_i = g_j, \qquad (1)$$

where l_i is the observed gravity value, observation i; ε_i is the error of observation i; g_j is the gravity value for point j.

8.3.2 Formulas for relative gravity data

Relative observation i of gravity point j with instrument n for the instrument level k with drift parameter m,

$$l_i - \varepsilon_i = \frac{\left(g^0{}_j - IL^0{}_k\right)}{SC^0{}_n} + (t_i - t_k\ ) \cdot DR^0{}_m + \frac{1}{SC^0{}_n} \cdot dg_j - \frac{1}{SC^0{}_n} \cdot dIL_k - \frac{\left(g^0{}_j - IL^0{}_k\right)}{(SC^0{}_n)^2} \cdot dSC_n + (t_i - t_k\ ) \cdot dDR_m\ , \qquad (2)$$

where l_i is the observed gravity value of observation i, ε_i is the residual of observation i, ${g^0}_j$ is the approximate gravity value for point j, ${IL^0}_k$ is the approximate instrument level for sequence k, t_i is the time of observation i, t_k is the time for the first observation in sequence k, ${SC^0}_n$ is the approximate scale correction for the instrument n, ${DR^0}_m$ is the approximate drift parameter of the drift sequence m, Δg_j is the correction to ${g^0}_j$ (i.e. the estimated difference between gravity value of point j and the corresponding approximate value), ΔIL_k is the correction to the instrument level, ΔSC_n is the correction to the scale correction and ΔDR_m, is the correction to the drift sequence.

For the cases the scale factor is set to 1, we have:

$$li - g_j - \varepsilon i = -IL_k + (ti - t_k) \cdot DR_m. \quad (3)$$

8.3.3 Formulas for precomputed differences

Precomputed differences (was used for the published land uplift observations and where we only had old gravity differences, but no raw observations):

For observation i of difference between gravity point j and gravity point p estimating a scale correction for instrument n,

$$l_i - \varepsilon_i = \frac{\left({g^0}_j - {g^0}_p\right)}{{SC^0}_n} + \frac{1}{{SC^0}_n} \cdot dg_j - \frac{1}{{SC^0}_n} \cdot dg_p - \frac{({g^0}_j - {g^0}_p)}{({SC^0}_n)^2} \cdot dSC_{\mathrm{n}}, \quad (4)$$

where l_i is the observed gravity value of observation i, ε_i is the error of observation i, ${g^0}_j$ is the approximate gravity value for point j, ${g^0}_p$ is the approximate gravity value for point p, ${SC^0}_n$ is the approximate scale correction for the instrument n, Δg_j and Δg_p are the corrections to the gravity point j and p, respectively, and ΔSC_n is the correction to the scale correction.

8.3.4 Formulas for sigma

The sigma value is the square root of a diagonal element in the C_{xx} matrix, where

$$C_{XX} = \left(\widehat{Variance}\right) \cdot A^T P A^{-1} \quad . \quad (5)$$

All observations with a sigma value between 2 and 3 are marked with "???" and all observations with a higher sigma value than 3 is marked with "###" in the output file from Gad.

8.4 Gad, output files

There are two output files from Gad, called "rg2000.result" and "rg2000relative.result".

8.4.1 The main result file

Here the result is presented in several ways. First, in the file some general information is presented according to this example:

Result file from GAd using input files from path: FINALFINALFINALFINAL

Data was generated: 2018-02-09 14:22

General information:

Total number of unknowns: 1405

Total number of equations: 4008

Total number of instruments: 18

Total number of absolute instruments: 4

Total number of relative instruments: 14

Number of gravity stations: 329

Number of absolute observations: 113

Number of relative observations: 3721

Number of precomputed differences: 174

Number of unknown scale corrections: 9

Number of unknown drift parameters: 213

Number of unknown instrument levels: 854

Standard uncertainty of unit weight:

Global: 0.75593014

Absolute: 1.31640601

Absolute FG5: 1.24977017

Absolute A10: 1.31903056

Relative: 0.74416254

PreComputed: 0.68441667

After that there is a list with all the adjusted gravity points according to this example:

Gravity points:

Nr:	Id:	Latitude:	Longitude:	Approximation:	Adjusted:	Correction:	Est std uncert:
1	BjoNB	68.443278	18.604556	982365.5280	982365.4858	-0.0422	0.0038
2	JukNA	67.850944	20.499333	982361.8920	982361.8562	-0.0358	0.0020
3	PelNA	66.797167	23.893250	982362.4360	982362.3968	-0.0392	0.0024
4	Jokkm	66.606333	19.822083	982347.3750	982347.3389	-0.0361	0.0034
5	Lansa	66.489861	22.444167	982349.8810	982349.8343	-0.0467	0.0029

After that, the adjusted absolute gravity points are presented according to this example:

Absolute gravity observations:

Flag:	Nr:	Id:	Latitude:	Longitude:	Measured:	Apriori std	Adjusted:	Residual:	Local red.	Est std unc.	Std res:	LDE:
	1	KirAA	67.877611	21.060194	982337.1857	0.0010	982337.1858	-0.0001	0.0342	0.0001	-0.9001	0.0114
###	2	GalAA	67.132222	20.659472	982341.1717	0.0050	982341.1625	0.0092	0.5979	0.0029	3.1379	0.0137
	3	TarAA	67.156722	22.636056	982387.1341	0.0050	982387.1322	0.0019	0.4382	0.0025	0.7710	0.0160
	4	KsuAA	68.441722	22.481028	982428.1761	0.0050	982428.1776	-0.0015	0.2704	0.0020	-0.7608	0.0204
	5	OveAA	66.397583	23.556806	982326.8551	0.0050	982326.8597	-0.0046	0.6876	0.0031	-1.4810	0.0128

After that, the adjusted relative observations are presented according to this example:

Relative gravity observations:

Flag:	Nr:	Id:	Measured:	Apriori std	Adjusted:	Residual:	Local red.	Est std unc.	Std res:	LDE:
	284	KsuAA	6227.3514	0.0050	6227.3521	-0.0007	0.5749	0.0029	-0.2491	0.0140
	285	Kares	6224.1035	0.0050	6224.1040	-0.0005	0.6038	0.0029	-0.1608	0.0136
	286	Kares	6224.1065	0.0050	6224.1041	0.0024	0.6025	0.0029	0.8192	0.0136
	287	KsuAA	6227.3514	0.0050	6227.3526	-0.0012	0.5801	0.0029	-0.4229	0.0139
	288	Galli	6144.3590	0.0050	6144.3606	-0.0016	0.6004	0.0029	-0.5630	0.0137
	289	GalAA	6140.3140	0.0050	6140.3151	-0.0011	0.6197	0.0030	-0.3577	0.0134
	290	GalAA	6140.3170	0.0050	6140.3152	0.0018	0.6200	0.0030	0.6086	0.0134
	291	Galli	6144.3620	0.0050	6144.3611	0.0009	0.5991	0.0029	0.3083	0.0137

After that, the adjusted precomputed differences are presented according to this example:

Precomputed differences observations:

Flag:	Nr:	Id1:	Id2:	Measured:	Apriori std	Adjusted:	Residual:	Local red.	Est std unc.	Std res:	LDE:
	37	StugB	StugA	-0.7379	0.0090	-0.7474	0.0095	0.9023	0.0065	1.4690	0.0201
	38	StugB	StugC	0.0499	0.0090	0.0588	-0.0089	0.7097	0.0057	-1.5452	0.0226
	39	StugB	StugD	-0.2185	0.0090	-0.2170	-0.0015	0.7097	0.0057	-0.2645	0.0226

After that, the computed scale factors are presented according to this example:

Estimated instrument scale correction:

Nr:	Name:	Approximation:	Adjusted:	Correction:	Est std uncert:
5	G54	1.000000	0.999971	-0.000029	0.000012

6	G290	1.000000	0.999967	-0.000033	0.000015
7	G54L	1.000000	0.999915	-0.000085	0.000034
8	G290L	1.000000	1.000023	0.000023	0.000044
9	G54Y	1.000000	0.999938	-0.000062	0.000020
10	G290Y	1.000000	1.000054	0.000054	0.000027
13	G54X	1.000000	0.999913	-0.000087	0.000021
14	CG5_1184	1.000000	0.999496	-0.000504	0.000014
15	CG5_740	1.000000	1.000178	0.000178	0.000034

After that, the computed drift parameters are presented according to this example:

Estimated instrument drift parameters:

Nr:	Approximation:	Adjusted:	Correction:	Est std uncert:
1	0.000000	0.004941	0.004941	0.024136
2	0.000000	-0.013078	-0.013078	0.001147
3	0.000000	-0.009658	-0.009658	0.001155

And finally, the computed instrument levels are presented according to this example:

Estimated instrument levels:

Nr:	Approximation:	Adjusted:	Correction:	Est std uncert:
1	976987.4632	976987.4349	-0.0283	0.0115
2	976987.4372	976987.4395	0.0023	0.0098
3	975387.5028	975386.3697	-1.1331	0.2184

8.4.2 The result file with the extra name "relative"

Here the result of the relative observations is presented in a more detailed way, according to the example:

Relative measures result file from GAd using input files from path: FINALFINALFINALFINAL

Data was generated: 2018-02-09 14:22

Relative gravity measures:

Nr: Id: DateTime: Measured: Adjusted:Difference

284 KsuAA 2015 8 14 - 12:38 6227.3514 6227.3521 0.0007

using estimated drift parameter: -538975931 0.0003 0.0008 using estimated instrument level: -538975655   976203.9625   0.0902

285 Kares   2015 8 14 - 13:19   6224.1035   6224.1040   0.0005

using estimated drift parameter: -538975931   0.0003   0.0008

using estimated instrument level: -538975655   976203.9625   0.0902

286 Kares   2015 8 14 - 13:42   6224.1065   6224.1041   -0.0024

using estimated drift parameter: -538975931   0.0003   0.0008

using estimated instrument level: -538975655   976203.9625   0.0902

287 KsuAA   2015 8 14 - 14:11   6227.3514   6227.3526   0.0012

using estimated drift parameter: -538975931   0.0003   0.0008

using estimated instrument level: -538975655   976203.9625   0.0902

288 Galli   2015 8 15 - 6:47   6144.3590   6144.3606   0.0016

using estimated drift parameter: -538975931   0.0003   0.0008

using estimated instrument level: -538975654   976203.9408   0.0890

289 GalAA   2015 8 15 - 7:19   6140.3140   6140.3151   0.0011

using estimated drift parameter: -538975931   0.0003   0.0008

using estimated instrument level: -538975654   976203.9408   0.0890

290 GalAA   2015 8 15 - 7:42   6140.3170   6140.3152   -0.0018

using estimated drift parameter: -538975931   0.0003   0.0008

using estimated instrument level: -538975654   976203.9408   0.0890

291 Galli   2015 8 15 - 8:10   6144.3620   6144.3611   -0.0009

using estimated drift parameter: -538975931   0.0003   0.0008

using estimated instrument level: -538975654   976203.9408   0.0890

8.5 Gcross

Gcross is a software for making leave-one-out cross validations for the absolute gravity observations. Leave-one-out cross validation means that first the absolute gravity observations of one certain point is excluded in one solution and the g value is calculated for that point. Then, the observation of that point is subtracted from the calculated g value and this procedure is automatically performed for every single absolute gravity observation. The input files are the same as for Gad.

8.5.1 Output file for Gcross

Here is an example of the output file:

Cross validation result file:

Data was generated: 2018-02-14 15:02

Nr: PointId: Latitude: Longitude: Measured: CrossVal: Diff:

1	KirAA	67.877611	21.060194	982337.1857	982337.1894	-0.0037
2	GalAA	67.132222	20.659472	982341.1717	982341.1564	0.0153
3	TarAA	67.156722	22.636056	982387.1341	982387.1297	0.0044
4	KsuAA	68.441722	22.481028	982428.1761	982428.1816	-0.0055
5	OveAA	66.397583	23.556806	982326.8549	982326.8619	-0.0070
6	ArvAA	65.595722	19.167139	982216.6108	982216.6093	0.0015

9 Calculation and FG5 adjustment

For the weighting in the adjustment, á priori standard uncertainties were used. In the following Sections and Subsections, the used á priori standard uncertainties are presented. These were naturally different for the different used kind of observations and for the main and second step realization, but also somehow different between the 2018 and 2019 realizations (see Subsection 7.4.4).

9.1 Formulas

See Section 8.3.

9.2 Weighting in 2017-18 (for the first realization)

During the adjustment in 2017-18 which led to the first realization of RG 2000, the weighting was performed and tested in different ways. As weights, á priori standard uncertainties were used. A Global Standard Error (GSE) was calculated for all observations, i.e. the absolute observations, the absolute FG5 observations, the absolute A10 observations, the relative observations and the precomputed differences. Please note that the most important thing concerning the á priori standard uncertainties are not the values themselves, but the relation between the different types of observations.

9.2.1 Á priori standard uncertainties for FG5 observations

For these observations, only two different numbers of á priori standard uncertainties were tested, 1 and 2 µGal. A value in between could be expected for the observations as the average value of time series of about 10 years, when the values have been transferred to the land uplift epoch 2000.0. The final GSE value for the FG5 observations was 1.25 (the ideal value is 1.0), which means that the á priori standard uncertainty of 1 µGal was a little too optimistic.

9.2.2 Á priori standard uncertainties for A10 observations

For these observations, all integer numbers between 3 and 10 µGal were tested for the á priori standard uncertainty. In the end 5 µGal were found to be adequate. Here, the GSE value for the A10 observations was 1.32, which also means that the á priori standard uncertainty of 5 µGal was a little too optimistic.

9.2.3 Á priori standard uncertainties for LCR observations

From start, the same á priori standard uncertainties as professor Lars Sjöberg at KTH *(Jansson and Norin 1990)* recommended for RG 82 were used. This means 10.5 µGal for G54 and 13.8 µGal for G290. As the GSE number for the relative observations was too low, the observations were better than expected. They were first changed to 10 µGal for G54 and 12 µGal for G290 and then to 9 and 11 µGal, respectively. Still, the GSE value was lower than 1.0. If we would have used even lower á priori standard uncertainties, the quality of these observations would not be realistic at all and there would be many more constraints between the different relative instruments. So, we decided to stop there. Note that Gad points out all observations that are considered as outliers (see Subsection 8.3.4). The observations with a sigma between 2 and 3 µGal get a question mark in front of the observation in Gad and in order to give those observations a bit more freedom it was decided to double their á priori standard uncertainties. The observations with a sigma larger than 3 get a "#" in front of the observation in Gad and those were removed. This procedure has influenced the GSE number for the relative observations and without it the GSE number would have been closer to 1.

9.2.4 Á priori standard uncertainties for Scintrex observations

Since there were two kinds of Scintrex observations, they had already from start different á priori standard uncertainties. The observations performed in the normal way had one á priori standard uncertainty and the observations performed in connection to gradient measurements of A10 points had another. The latter kind of observations meant that a mean of the 12 observations at the bottom were averaged and got connected to the next point where gradient measurements were performed via the average of the 12 bottom observations there. These observations were only connected to observations performed the same day, which means that something between 2 and 4 observations were connected to each other per day. In the end, these got an á priori standard uncertainty of 12 µGal. For the first kind of observations (the normal observations), after a while the used instruments also got two different á priori standard uncertainties. CG5-1184 was found to be the by far best of the relative instruments and got in the end the á priori standard uncertainty 7 µGal. The rest got the á priori standard uncertainty 9 µGal. After that, the same procedure with the observations and sigma were performed as for the LCR observations.

9.2.5 Á priori standard uncertainties for precomputed differences

As previously stated, there are two kinds of precomputed differences. Those from the land uplift gravity lines, observed by several different LCR model G instruments and those where the observations themselves were not found between RG 82 Zero Order Network main points and RG 82 Zero Order Network spare points. When typing the input files for the first category it was already noticed that they differed quite a lot and much more than expected since they are means of observations. It was even more obvious after running them in Gprep, when all differences got the same epoch. Therefore, it was decided to use the same á priori standard uncertainty here as for the normal relative observations. They eventually got the value 9 µGal. From the start, when deriving scale factors to all the involved instruments, the scale factors and the result seemed unrealistic, thus all other involved instruments than G54 and G290 were finally treated as one instrument, GNordic, with the predetermined scale factor 1.0.

The second category of precomputed differences were taken from a report *(Haller, Ekman 1988)*, but the observations themselves were not found. When just typing the differences in the input file and using the instrument "Known" with the scale factor of 1 µGal, the quality of the results was low, since there was just one observation for these particular RG 82 Zero Order Network spare points. The solution was to copy these observations and use them twice but then with a higher number of á priori standard uncertainty for the copy than the original data. It influenced the GSE number largely. The value of 0.68 for the precomputed differences indicates that the observations are underrated.

9.2.6 Á priori standard uncertainties, special cases

There were a few special cases when we used a certain á priori standard uncertainty. In this Subsection these will be described, but first there is a sum-up for the Subsections 9.2.3-9.2.5 and Table 4 with some extra information.

Observations from G54 and G290 were assigned with different instrument names, due to the fact that their scale factor seems to have changed in time:

- CG5-198 = 9 µGal
- CG5-740 = 9 µGal
- CG5-1184 = 7 µGal
- G54/X/Y/L = 9 µGal
- G290/Y/L = 11 µGal
- GNordic = 9 µGal

Here, G54 and G290 are the observations with G54 and G290 performed in 1981-1982 for RG 82 and the few observations performed before those years. G54L and G290L are the observations with G54 and G290 performed during 1983-1996. G54Y and G290Y are the observations with G54 and G290 performed during 2001-2013. G54X are the observations with G54 performed during 2015-2017. GNordic are the additional instruments used during the land uplift gravity line campaigns.

Exceptions:

- Forward and backward observations of benchmarks outside Class A huts (or similar): 1184 = 3 µGal; G54 = 6 µGal
- Forward and backward observations with a gravity range less than 0.2 mGal: 1184 = 4 µGal; G54 = 7 µGal
- Forward and backward observations with a transportation time less than 15 minutes and a gravity range less than 3 mGal: 1184 = 4 µGal; G54 = 7 µGal; 740 = 6 µGal
- Forward and backward observations with a transportation time less than 30 minutes and a gravity range less than 5 mGal: 1184 = 5 µGal; G54 = 8 µGal; 740 = 7 µGal

- Forward and backward observations with a transportation time less than 45 minutes and a gravity range less than 10 mGal: 1184 = 6 µGal; 740 = 8 µGal; 198 = 8 µGal
- Observations in connections to gradient mesurements: 740 = 12 µGal; 1184 = 12 µGal; G54 = 18 µGal
- Observations on the gravity land uplift lines: All = 9 µGal
- (Only for 2nd adjustment: At long distances (longer than 1 hour between the points): G544 = 40 µGal; G2900 = 40 µGal. The rest of the instruments have their normal weights in this case.)
- When it is known from protocol books or own experience that the instrument has worked less well: Double the normal á priori standard uncertainty.
- When the standardized residual is between 2 and 3: Double the normal á priori standard uncertainty or make it 1,5 times larger in case it is very close to 2. If the series already has the double value for other reasons, give it 3 times normal á priori standard uncertainty.
- When the observation indicates a number over 3 sigma: Remove!

9.3 Weighting in 2019 (for the new realization)

Exactly as during the adjustment in 2017-18, during the adjustment in 2019 the weighting was performed and tested in a few different ways and is summarized in the following Subsections.

9.3.1 Á priori standard uncertainties for FG5 observations

A new approach was used for these observations. The calculated standard uncertainties for the point series at epoch 2000.0 was used as the á priori standard uncertainty. It means that the numbers were between 1.4 and 2.0 µGal, which seems very realistic. However, the two points with the least number of observations, Borås AA and Onsala AB, got very low standard uncertainties due to the low number of observations. This means that the both got 2.0 µGal as á priori standard uncertainty. The GSE value for the FG5 observations was finally 1.06, which means that the á priori standard uncertainty fits very well even if it still is a little optimistic.

9.3.2 Á priori standard uncertainties for A10 observations

After the gross error in Holmsund AA was found, the previous á priori standard uncertainty of 5 µGal for the A10 observations was considered as too low. After testing, 7 µGal was found as the best. Here, the GSE value for the A10 observations finally was 1.09, which fits quite well even if it still means that the á priori standard uncertainty was a little optimistic. However, since the A10 and the CG5-1184 observations now have the same normal á priori standard uncertainties, it feels inappropriate to try to get the GSE value even closer to 1 for the A10 observations.

9.3.3 Á priori standard uncertainties for LCR observations

The same á priori uncertainties were used as for the 2018 realization but there were two major differences due to that more data was included. Half of the new data was previously lost observations between the RG 82 Zero Order Network main points and spare points. They and the very few new data from 2019 was treated exactly the same way as in Subsection 9.2.3 and in Subsection 9.2.6. The other half of the new data came from previously excluded observations. These were data where it was unclear if it had gross errors and thus were tested again. Some of them got excluded again as gross errors, but most of them were less good observations which got the double á priori standard uncertainty. Similarly, previous observations with double á priori standard uncertainty were tested again and approximately half of them got the normal standard uncertainty after that. On another note, one day of observations in 1987 and one day of observations in 1993 with both G54 and G290 along the land uplift gravity lines were now found so bad so they were rejected. The GSE value finally became 0.79 for the relative observations (the observations in this Subsection and in Subsection 9.3.4).

9.3.4 Á priori standard uncertainties for Scintrex observations

Here, apart from that many more observations were included, the difference to Subsection 9.2.4 was that the observations with double á priori standard uncertainty were tested again, exactly as in Subsection 9.3.3. Since the normal á priori standard uncertainty of CG5-1184 and A10 is the same now, the CG5 á priori standard uncertainties were not changed to an even lower number, as supported by the GSE value.

9.3.5 Á priori standard uncertainties for precomputed differences

There were three differences to the data used in the realization in 2018. First, all the computed differences between the RG 82 Zero Order Network main points and RG 82 Zero Order Network spare points were excluded, since the real observations were found. Second, it was tested to change the á priori standard uncertainty to a lower number. We used 7 µGal, although Gad indicated it as a too high number. Third, the observed difference with FG5X-233 between Ratan AA and Holmsund AA from 2019 was included and got the á priori standard uncertainty 2 µGal. As previously stated, when looking at the differences between the observations at the land uplift gravity lines, they are in general less good than what could be expected as average with such instruments. This means that lower numbers than this is not at all realistic. The GSE value finally became 0.82.

9.3.6 Á priori standard uncertainties, special cases

These are exactly the same as for the observations of the 2018 realization, see Subsection 9.2.6. It should though be mentioned that there were 4 relative observations where the sigma value was between 2.0 and 2.1 which still got the normal á priori standard uncertainty.

9.4 Main adjustment in 2018

In the main RG 2000 adjustment in 2018, the FG5 observations got the á priori standard uncertainty 1.0 µGal, the A10 observations 5.0 µGal, the relative observations after certain criteria (normal value of 9.0 µGal (see Subsection 9.2.6) and most precomputed differences 9.0 µGal (see Subsection 9.2.5). Concerning the A10 observations and the relative observations, several different alternatives were tested before it was decided which á priori standard uncertainties should be used. 329 points were included in the main RG 2000 adjustment, of which 328 are in Sweden. During the adjustment, one gross error in one of the A10 observations was found and here the relative observations gave the point its g-value.

9.4.1 Details about the main adjustment in 2018

The first run in Gad was performed in late April 2017, when not all observations were performed yet. It started as an iterative process, to get all gravity data into the input files and then getting the correct output file. After all data was available, several numbers of different weighting were tested. The FG5 observations were all collected into one observation per station and the initial á priori standard uncertainty value was 1 µGal. Also 2 µGal was tested but with less good result. The A10 observations were separated and the points which A10 had occupied twice first had two such observations (later changed to one). These observations were tested with all possible integer numbers between 10 and 3 µGal as á priori standard uncertainties. 5 µGal seemed to give the best result. The relative observations had from start 11 µGal, but it was found out that it was better to give different instruments different á priori standard uncertainties.

From the start, all observations but the ones for the FAMOS points were included in the main adjustment. It was then discovered that the observations from 1973 (see Subsection 7.2.1) affected the better observations in such a way that they must be removed.

When the observations from 1973 still were in the adjustment, all observations by the same instrument had the same scale factor. When we first divided the instruments between 1973 and the rest of the years, the results got better. Then the instruments G54 and G290 were divided a few more times regarding the years, leading to better results. In the end, after removing the observations from 1973, we divided the instrumental scale factors according to Table 7.

Table 7: *Adjusted scales for the different relative gravimeters.*

Name	Approximation	Adjusted	Correction	Estimated standard uncertainty
G54 1981-82	1.000000	0.999971	-0.000029	0.000012

G54 1984-96	1.000000	0.999915	-0.000085	0.000034
G54 2001-04	1.000000	0.999938	-0.000062	0.000020
G54 2015-17	1.000000	0.999913	-0.000087	0.000021
G290 1981-82	1.000000	0.999967	-0.000033	0.000015
G290 1984-96	1.000000	1.000023	+0.000023	0.000044
G290 2001-03	1.000000	1.000054	+0.000054	0.000027
CG5-740	1.000000	1.000178	+0.000178	0.000034
CG5-1184	1.000000	0.999496	-0.000504	0.000014

For all other instruments used only for the observations along the land uplift gravity lines, the factor was set to 1. When it comes to so small magnitudes as along a land uplift gravity line (less than 1 mGal between the points), a real scale of 0.999900 influences the g-value less than 0.1 µGal. When calculating a scale factor there, we found out that there are too few observations and the error in the observation is too large in comparison. This meant that when using scale factors also for these instruments, the scale is unreliable affecting the observations.

For 6 other instruments the scale was also set to 1, which means:

- G290 after the repair in 2012 (two observations in computed differences).
- The two Danish Scintrexs used at the same time as G290 in 2012 (two observations each in computed differences).
- Scintrex CG5-198 between Kramfors AA and Kramfors AB in 2008 (8 observations in the relative file), where the difference is smaller than 1 mGal.
- Scintrex CG5-198 (after it was repaired) between Saxnäs and Klimpfjäll AA (4 observations in connection to a campaign of so-called geoid measurements by helicopter).
- G2900 and G544 were the observations with G290 and G54, respectively, between 1975 and 1977. Both had very uneven quality concerning at least the long distances (long, both in gravity and travel time) and mostly had smaller gravity differences between main points of RG 82 and spare points (even if they at this time not yet were RG 82 points and were called main points of the gravity land uplift lines and spare points of the same).

For 7 of the old RG 82 Zero Order Network sites (Göteborg, Jukkasjärvi, Kåbdalis, Mårtsbo, Södertälje, Västervik and Ödeshög), the observations between the A and the B point had not been found in any protocol book or any data file. Here, we have used the difference from *Haller, Ekman (1988)* as precomputed differences with scale factor 1. Of these B points, only Göteborg NB and Mårtsbo B have been used further. Göteborg NB has replaced Göteborg AA as the main point in Göteborg and

Mårtsbo B was used in 1975 for some additional observations and in 2012 and 2017 for connection to Mårtsbo AA/AB.

Note that for G54 and G290, the old scale factors 1.00075 (G54) and 1.00083 (G290) were used in all pre-calculations and that the new scale factors are these old scale factors multiplied with the adjusted scale factors.

9.4.2 Single connected points in the main adjustment in 2018

Even if the goal was that there should be as few single connected points as possible, there are a few which are such, in five different categories. With a single connected point, we mean a point which only is connected to one other point by relative gravimetry.

1. The single connected points which have been observed with FG5 or A10 should not be counted as a real single-connected point. Anyhow they are: Kiruna AA, Lycksele AA, Smögen AA, Holmsund AA, Borgsjö AA, Härnösand AA, Höör AA, Sollefteå AA, Sölvesborg AA and Örnsköldsvik AA.
2. The single connected points which have been used in the second step adjustment are: Algutsboda 1p, Arvidsjaur 1p, Dörby 1p, Hörnefors 1p, Jönköping 1p, Kristianstad 1p, Stora Tuna 1p, Särna 1p, Örebro 1p and Övertorneå 1p.
3. The single connected points which are situated right outside the huts of FG5 points. These points are only established in order to get access to a good gravity point without having access to the hut. These are: Arjeplog B, Ratan B and Visby D.
4. The single connected points which are spare points in the RG 82 Zero Order Network are: Göteborg AA, Jukkasjärvi NB, Kåbdalis NB, Södertälje NB, Västervik NB and Ödeshög NB. These points were established in case one of the main points should be destroyed. Göteborg AA was at first the main point, but already during the observations in 1981 for the Zero Order Network, the point Göteborg NB was the point used for relative observations.
5. The remaining single connected points are: Ammarnäs, Gotska Sandön, Jämjö 1p, Skönberga 1p, Södra Fågelås 1p and Uppsala C 1p.

9.5 Main adjustment in 2019

In the main RG 2000 adjustment in 2019, the FG5 observations got an á priori standard uncertainty between 1.4 and 2.0 µGal, the A10 observations 7.0 µGal, the relative observations after certain criteria (normal value of 9.0 µGal, see Subsection 9.2.6) and the precomputed differences 7.0. µGal. Concerning the A10 observations and the relative observations, several different alternatives were tested before it was decided which á priori standard uncertainties should be used. 343 points were included in the main RG 2000 adjustment, of which 342 are in Sweden.

9.5.1 Details about the main adjustment in 2019

As previously written, in the introduction to Chapter 9 and in Table 4, the scale factors were divided slightly different than in the main adjustment of 2018. One difference was that some new observations from 1980 were added for both G54 and G290, respectively. These were now included in the scale factors previously derived from the years 1981-82. A second difference was that the scale factor for the years 1984-96 were added together with the scale factor for the years 2001-03/14, respectively. A third difference was that the scale factor for CG5-198 was derived for the year 2019. The derived instrumental scale factors can be seen in Table 8.

Table 8: *Adjusted scales for the different relative gravimeters*

Name	Approximation	Adjusted	Correction	Estimated standard uncertainty
G54 1980-82	1.000000	0.999976	-0.000024	0.000013
G54 1984-2013	1.000000	0.999937	-0.000063	0.000017
G54 2015-19	1.000000	0.999904	-0.000096	0.000022
G290 1980-82	1.000000	0.999971	-0.000029	0.000015
G290 1984-2003	1.000000	1.000042	+0.000042	0.000020
CG5-198	1.000000	0.999326	-0.000674	0.000058
CG5-740	1.000000	1.000178	+0.000178	0.000031
CG5-1184	1	0.999494	-0.000506	0.000015

Note that for G54 and G290, still the old scale factors 1.00075 (G54) and 1.00083 (G290) were used in all pre-calculations and that the new scale factors are these old scale factors multiplied with the adjusted scale factors.

9.5.2 Single connected points in the main adjustment in 2019

The single connected points are in the same five categories as in Subsection 9.4.2, but there are some changes in the points.

1. The single connected points which have been observed with FG5 or A10 should not be counted as a real single-connected point. Anyhow they are: Kiruna AA, Lycksele AA, Smögen AA, Holmsund AA, Borgsjö AA, Härnösand AA, Höör AA, Sollefteå AA, Sölvesborg AA and Örnsköldsvik A.

2. The single connected points which have been used in the second step adjustment are: Algutsboda 1p, Arvidsjaur 1p, Bureå 1p, Dörby 1p, Granberget 1p, Hamrånge 1p, Hörnefors 1p, Jämjö 1p, Jönköping 1p, Kristianstad 1p, Nysätra 1p, Skönberga 1p, Stora Tuna 1p, Särna 1p, Södra Fågelås 1p, Uppsala C 1p, Vassijaure 1p, Örebro 1p, Örnsköldsvik 1p and Övertorneå 1p.
3. The single connected points which are situated right outside the huts of FG5 points are: Arjeplog B, LMV Pol 7, Lycksele D, Onsala A, Onsala B and Visby D.
4. The single connected points which are spare points in the RG 82 Zero Order Network are: Göteborg AA, Jukkasjärvi NB, Kåbdalis NB, Lycksele C, Södertälje NB, Västervik NB and Ödeshög NB.
5. The single connected points are the following: Ammarnäs and Gotska Sandön.

9.6 Second step adjustment in 2018

The second step adjustment had two main purposes. The first was to get good adjusted values for the FAMOS points, the second was to get more connections between RG 2000 and RG 62. More than half of the observations in this adjustment are old and less reliable observations, connecting different RG 62 points of which some are Class B points in RG 2000.

9.6.1 Weighting

Here, the á priori standard uncertainty of the points previously determined in the main RG 2000 least squares adjustment first was set to 1 µGal. Then the weighting of the relative observations changed some of them about 1 µGal, which led to that the á priori standard uncertainty was set to 0.1 µGal in order to leave them unchanged. The Scintrex observations for FAMOS were set to 10 µGal for CG5-198 and CG5-740. The observations from 1973 were set to 20 µGal for both used instruments. Like in the main adjustment, the observations with a sigma between 2 and 3 got the double weighting and the observations with a sigma larger than 3 were rejected.

9.7 Second step adjustment in 2019

The second step adjustment in 2019 was divided into two different runs in the adjustment. First, one with the whole RG 62 network plus some additional points (see Subsection 7.2.1) and second, one with the FAMOS points.

9.7.1 Weighting

Here, the same á priori standard uncertainties as in Subsection 9.6.1 were used for the “absolute points”, for the FAMOS points and for the observations from 1973. The adjusted RG 62 observations were used as precomputed differences with the á priori standard uncertainty 40 µGal. Like in the main adjustment, the observations with a sigma between 2 and 3 got the double weighting and the observations with a sigma larger than 3 were rejected. But for the RG 62 observations, several á priori standard uncertainties in the precomputed differences where the sigma was between 2.0 and 2.5 were left as was. A few observations in Norway with sigma larger than 3.0 got a higher á priori standard uncertainty for keeping the network structure and for giving the points a value in RG 2000.

10 Results

In the following Sections, the result in the two main adjustments and the two second step adjustments are presented respectively.

10.1 Main adjustment in 2018

In the final solution of the main adjustment the total numbers were the following:

- Total number of unknowns:	1405
- Total number of equations:	4008
- Total number of absolute instruments:	4
- Total number of relative instruments:	14
- Number of gravity points:	329
- Number of absolute observations:	113
- Number of relative observations:	3721
- Number of precomputed differences:	174
- Number of unknown scale corrections:	9
- Number of unknown drift parameters:	213
- Number of unknown instrument levels:	854

The standard uncertainty of unit weight for

- All observations is	0.76
- The FG5 observations is	1.25
- The A10 observations is	1.32
- The relative observations is	0.74
- The precomputed differences is	0.68

It means that the weights were slightly overestimated for the absolute gravity observations and slightly underestimated for the relative observations. Still, at the time we thought that this was the best possible solution, as we for other reasons were convinced that the absolute observations were more trustworthy.

The article *Engfeldt et al. (2019)* is about this solution and in the Figures 58, 59, 60 and 61 some statistics are presented.

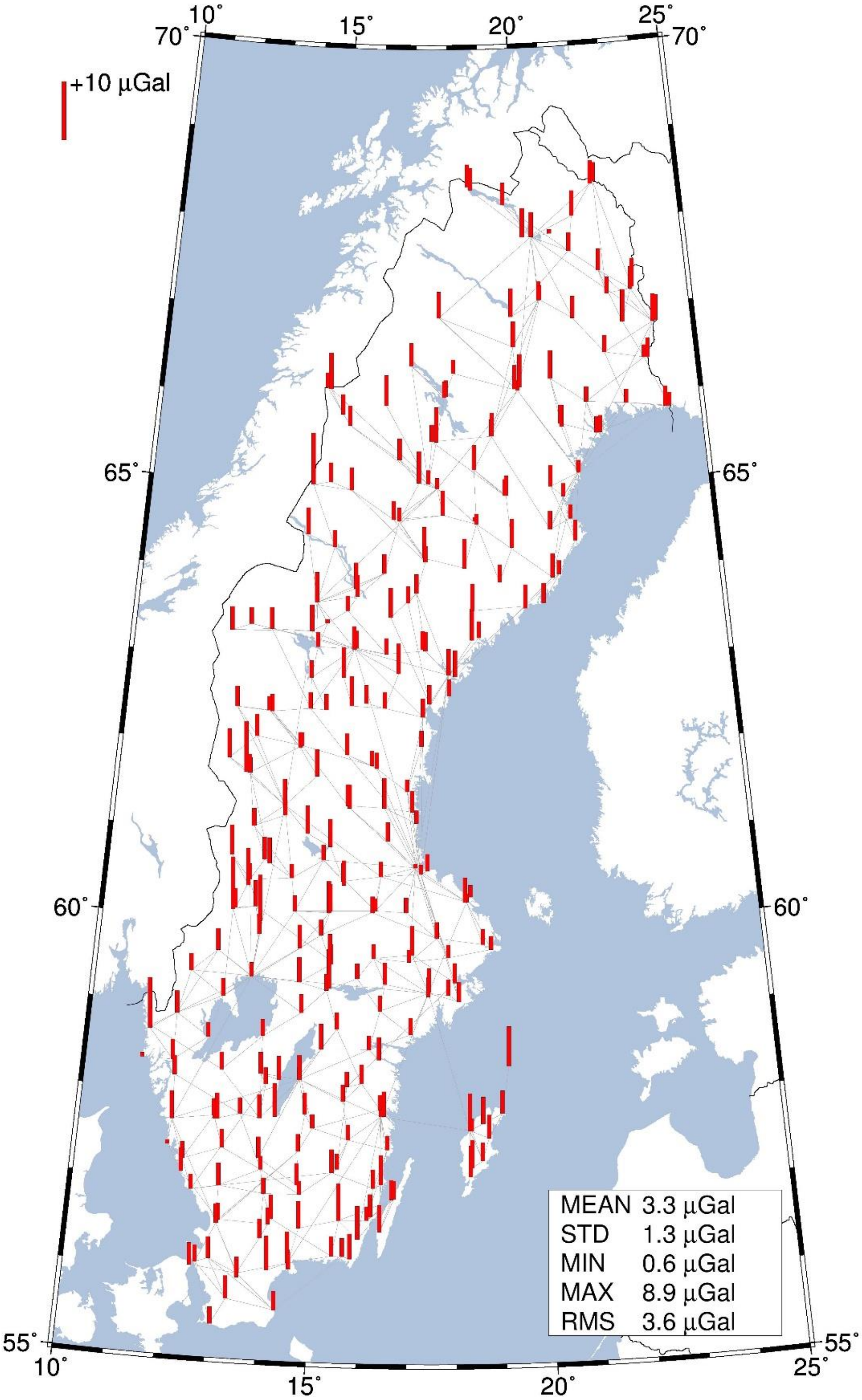

Figure 58: *The estimated error in the points.*

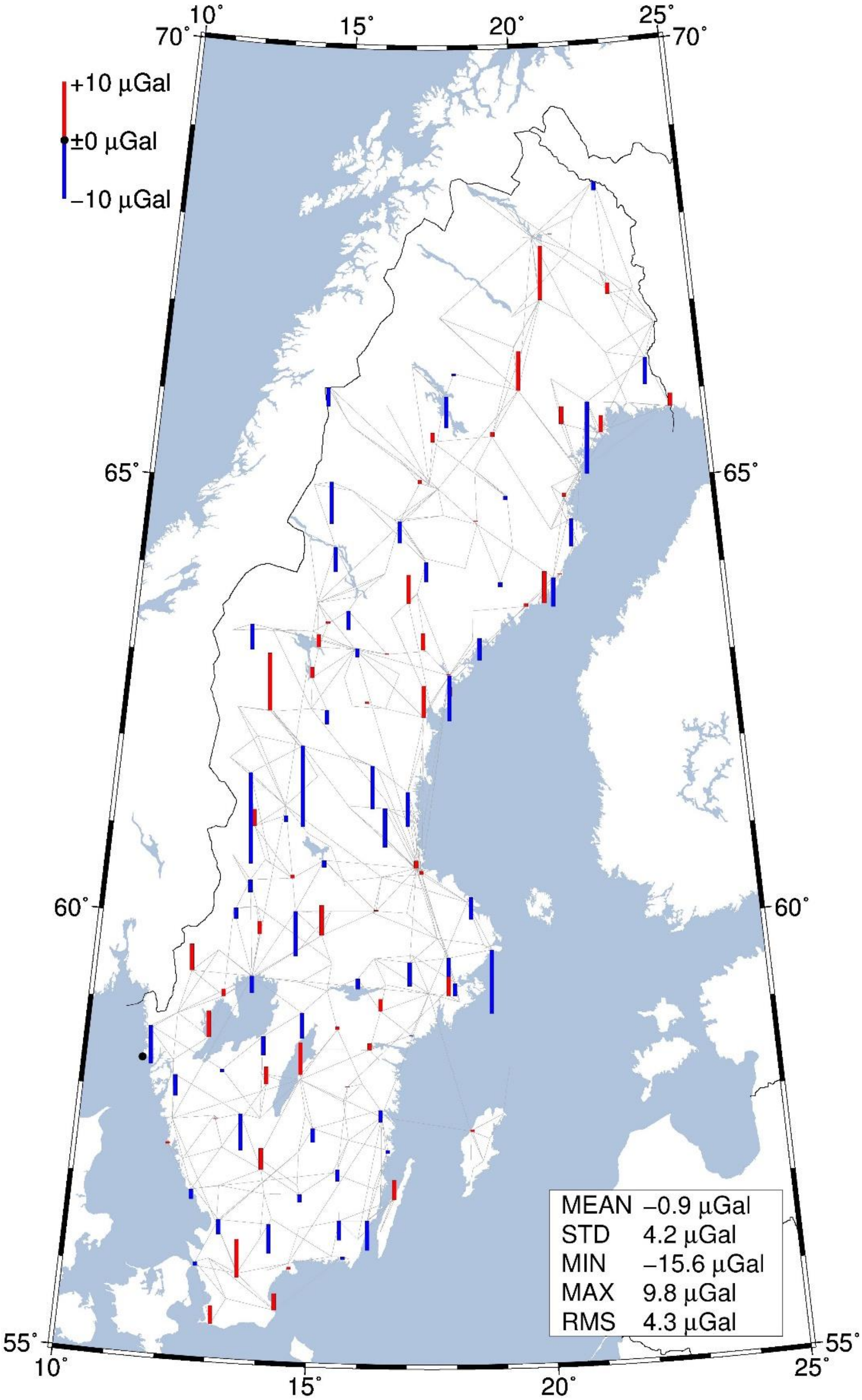

Figure 59: *The residual of the results for the absolute observations. The larger the value, the more the value has changed in the adjustment.*

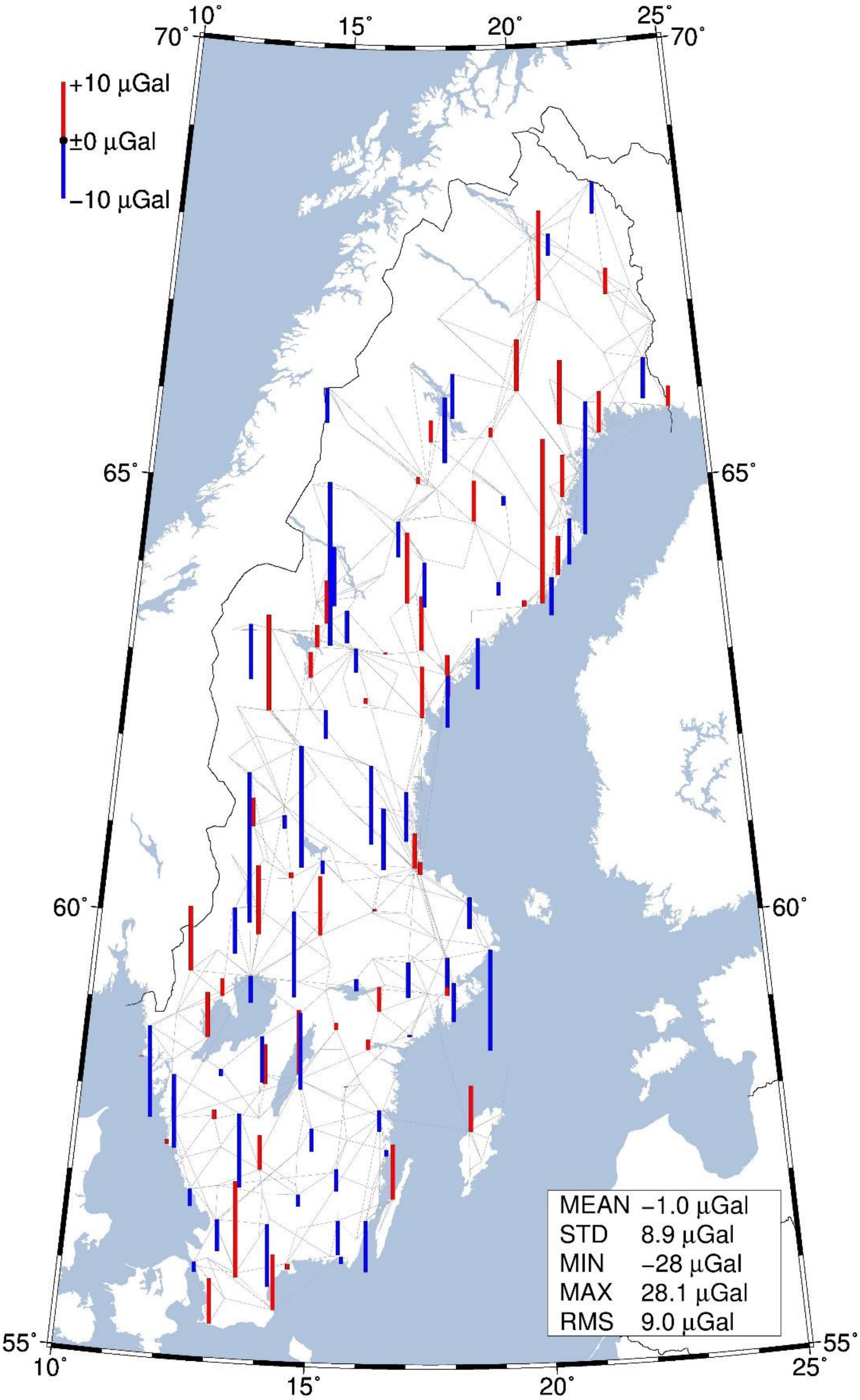

Figure 60: *The result from the leave-one-out cross validation of the absolute observations.*

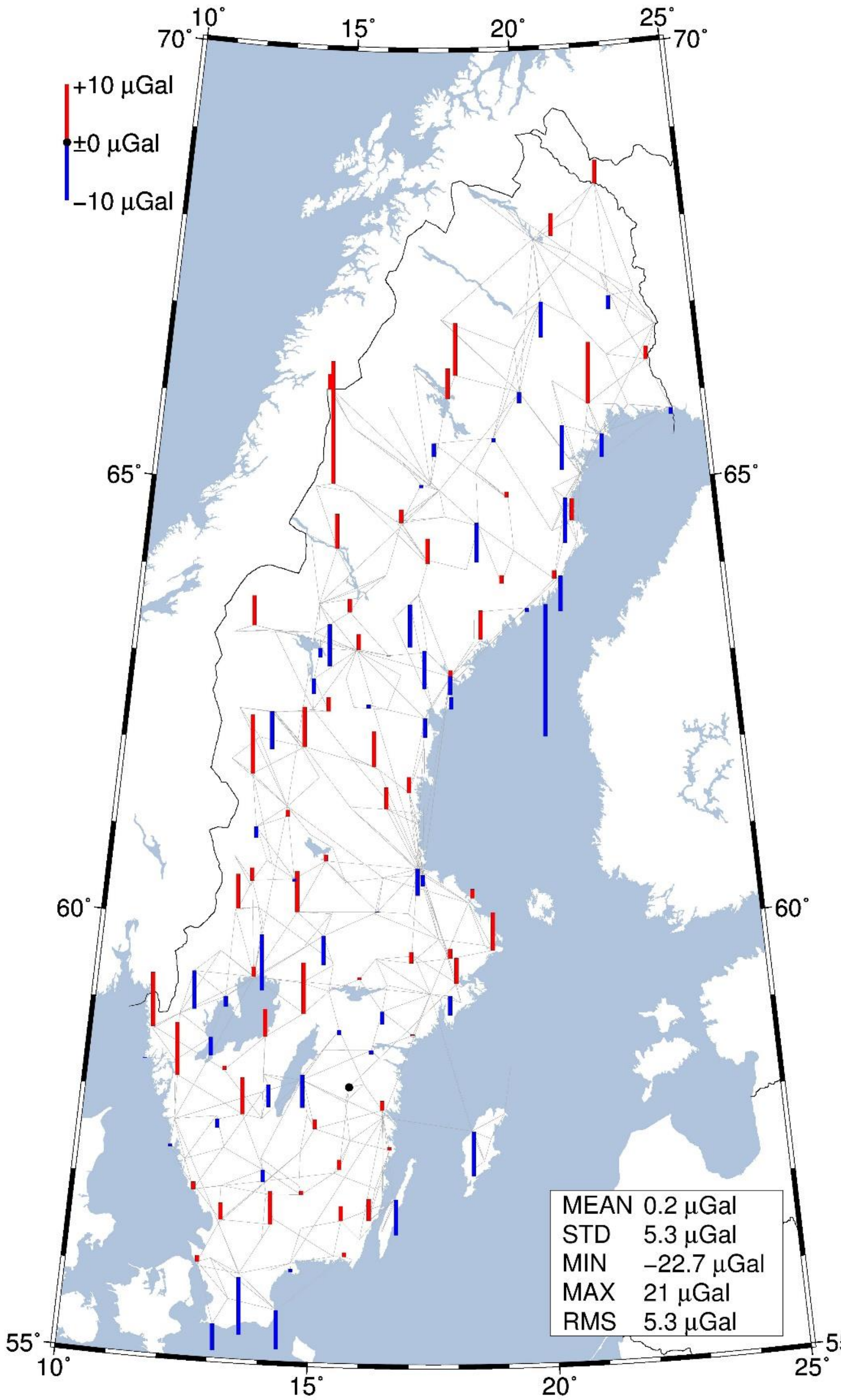

Figure 61: *The difference between the adjusted result and the leave-one-out cross validation. The larger the value, the less the absolute gravity observation and the relative gravity observations correspond to each other.*

10.1.1 Irregularities/anomalies in the result

Holmsund AA. This point is very special in several ways. The point itself is exactly like a Class A point even if the only instrument which had measured there before

2019 was the A10-020 (note that the point now is upgraded to Class A). However, the leave-one-out cross validation showed a misfit between absolute (A10) and relative observations. In June 2019, we decided to check if the A10 observation was a gross error by using FG5X-233 as a very good relative gravimeter by observing in Holmsund AA and in Ratan AA. The result was that the error in the A10 observation was even larger than suspected, about 35 µGal (28.1 µGal according to the cross validation). This fact eventually led to a new realization of RG 2000 in 2019.

Klimpfjäll AA. This is the second worse point after the leave-one-out cross validation. This point can though not be controlled by any FG5. There were three hypotheses: The first was that some of the relative observations to the point Saxnäs, which is a backbone to almost all connections to Klimpfjäll AA, are less good and that the A10 observation in Klimpfjäll AA is reliable. The second was that half the “error” depends on the A10 observation and half the “error” depends on the relative observations. The third was that if Holmsund AA could be more than 30 µGal wrong, then Klimpfjäll could be 28 µGal wrong. There were two ways to control this, to re-measure with A10 or to re-measure Saxnäs or Klimpfjäll AA to Vilhelmina AA which we regard as a very good point. In the latter case, also Stekenjokk should get a better connection to Klimpfjäll AA. In September 2019 relative observations from Vilhelmina AA – Saxnäs – Klimpfjäll AA – Stekenjokk forward and back were performed. The result can be found in Subsection 10.2.1.

Särna AA. This point is the third worse point after the leave-one-out cross validation. It is also the point observed with A10 which changed the most after the adjustment, which means that the value in RG 2000 is closer to the leave-one-out cross validation value than the value of the A10 observation, see Figure 61.

It should also be pointed out that two irregularities in the A10 data was found before the final version of the adjustment: The observation in 2012 at Transtrand AA was “correct” and the observation in 2015 at Transtrand AA included a gross error in the size of 30 µGal. It was also found out after a previous leave-one-out cross validation that the observation in 2015 at Voxna AA had a very large gross error in the size of 70 µGal, which in autumn 2017 was confirmed by more relative observations.

It is noticeable that the formula in Gad for sigma was wrong in the software until early 2018, when this was found and was changed. All observations regarded as outliers were removed before this change. The first realization was then almost regarded as finished, but a few extra runs in Gad had to be performed with some changes in the á priori standard uncertainties, but unfortunately without adding back the previously removed observations. After the first realization was published, it was found out that several of these removed observations were not as bad as the statistics first showed. This means that they should have been left in this adjustment, though mostly with the double á priori standard uncertainty as the normal, as they were treated in the second adjustment.

10.1.2 Destroyed points and less good points

Some points which have been used in the adjustment have been destroyed after the observations took place. Though, the observed differences between them and other still existing points are very interesting and useful and to include them in the adjustment strengthening up the network itself.

The destroyed points we know are: Alby, Hofors A, Mora, Rättvik and Torsby. The point Gothem is unusable if a wooden structure on the church step is not removed. We also suspect that Visby NB is destroyed. Särna, Tanum, Västervik NB and Höör A are situated below a lot of soil and grass or branches and the point descriptions are not good enough to find them easily.

The point Kiruna A 1p should not be used, since the mine has come much closer to the point after it was measured and the g value has without doubts changed a lot. The points Hemse 1p and Tingstäde 1p had at the time no site descriptions. We only knew that they are situated somewhere around these churches. The point Enköping is situated along a big road where there is no parking place nearby. In 2017, the road was changed to a 2+1 road with central barrier, which means that the point now is not accessible at all.

The point Älvdalen B is less accessible and nearby there are other points (Älvdalen AA and Älvdalen A) with much better access. The point Stensele A is also difficult to reach, but here the distance to better points (Stensele AA and also Stensele B) is longer.

The piece of bedrock on which the point Fredrika is situated on is nowadays half buried under filling masses for a rest area. Even if the point itself can be seen, the g-value has surely changed so it is considered unusable. The point Arvidsjaur must have been run over by a snow plough in 2012 or 2013. The bolt is bended and mostly destroyed, but in 2016 the point could still be used. However, the nearby situated Arvidsjaur AA (and Arvidsjaur 1p) are recommended instead. The area around the point Säffle AA has been changed a lot after the A10 observations in 2011. Very close to the point a new roundabout was built and the bedrock was damaged (see Figure 24). Still, an observation in 2017 shows that the g-value has changed very little, if at all.

The point Sorsele and the point Ånn were both observed in 2001, when June and the beginning of July was very dry. When returning to them at other times, it is obvious that they should never have been chosen, since their surrounding is very wet in normal years. Therefore, the point Sorsele AA is recommended instead of Sorsele and the point Duved AA is recommended instead of Ånn even if the distance between the latter is about 20 km.

The points Åsele and Pello NB are both situated on bedrock where big bushes have grown after the observations took place and now are occupying the whole area where the gravimeter previously stood. These must be removed before they should be used again. However, the points Åsele AA and Pello NA, respectively, are recommended instead.

If observing at the points Lövånger (in particular, see Figure 23) and Avesta, a small extra (like coins or a stable small stone) is recommended to use under one of the tripod's feet. The bedrock is too much inclined to get the instrument in level.

Göteborg AA is situated at Chalmers and indoors, in a locked room filled with used furniture. To find the bolt, lots of chairs and tables need to be moved. The key to the door can only be obtained from a property company. Note that the site description in *Cannizzo, Cerutti (1978)* should be used if someone will look for the point. Otherwise, the point Göteborg NB less than 50 meters from this building is recommended instead.

The point Gotska sandön is located on the island with the same name and a National Park, far away from the main land and far away from the island of Gotland. This point has not been visited after it was observed in 1984, so its status is unknown.

The point Kastlösa on Öland is situated in dense thorne shrubs. When being observed for the second time in 2016 (first time was 2002) a path through the bushes had just been cut by a levelling team, but the path is probably already gone again.

In *Haller, Ekman (1988)* a point called Lycksele C is mentioned without a g-value, just saying that it will be observed later. During the search of old observations in protocol books, the observations were not found since they were not at the correct place in the Geodetic archive until 2019. Therefore, it was not included in this realization. There is a point called Karlstad NB which was reported destroyed in the 1990s. That point is also not included here, since no observations have been found (even if a g-value exist in that publication) and no one has ever used it. The rest of the points in *Haller, Ekman (1988)* has a g-value from the first realization of RG 2000.

10.2 Main adjustment in 2019

In the final solution of the main adjustment the total numbers were the following:

- Total number of unknowns:	1524
- Total number of equations:	4392
- Total number of absolute instruments:	4
- Total number of relative instruments:	13
- Number of gravity points:	343
- Number of absolute observations:	112
- Number of relative observations:	4124
- Number of precomputed differences:	156
- Number of unknown scale corrections:	9
- Number of unknown drift parameters:	249
- Number of unknown instrument levels:	924

The standard uncertainty of unit weight for

-	All observations is	0.80
-	The FG5 observations is	1.06
-	The A10 observations is	1.09
-	The relative observations is	0.79
-	The precomputed differences is	0.82

It means that the weights still were slightly overestimated for the absolute gravity observations and still slightly underestimated for the relative observations. Still, we think that this is the best possible solution, as we for other reasons are convinced that the absolute observations are more trustworthy.

In Figure 62, 63, 64 and 65, some statistics are presented for this solution. All the g-values and the coordinates of the points included in the final solution of the 2019 realization of RG 2000 can be found in Table 9.

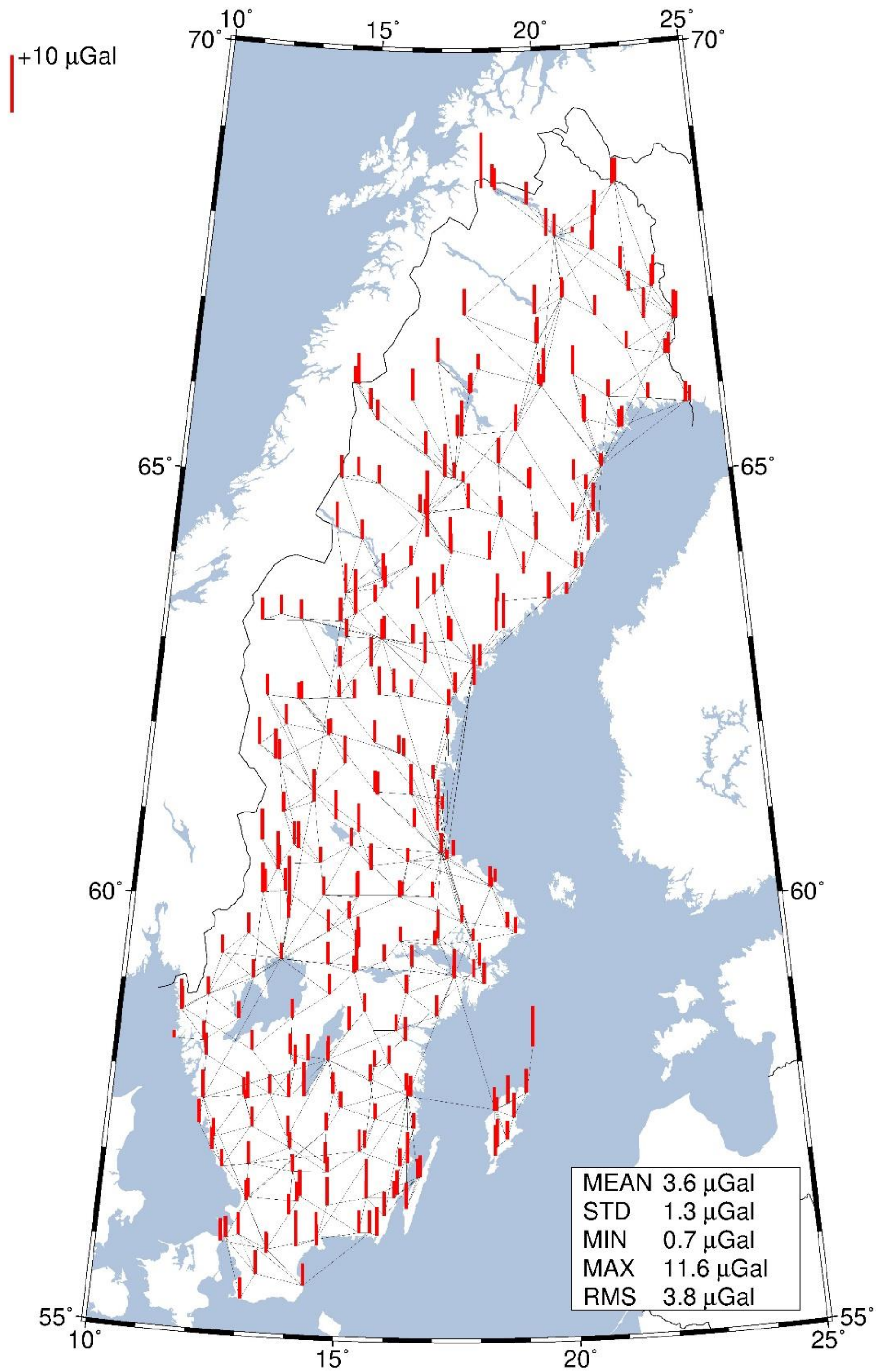

Figure 62: *The estimated error in the points.*

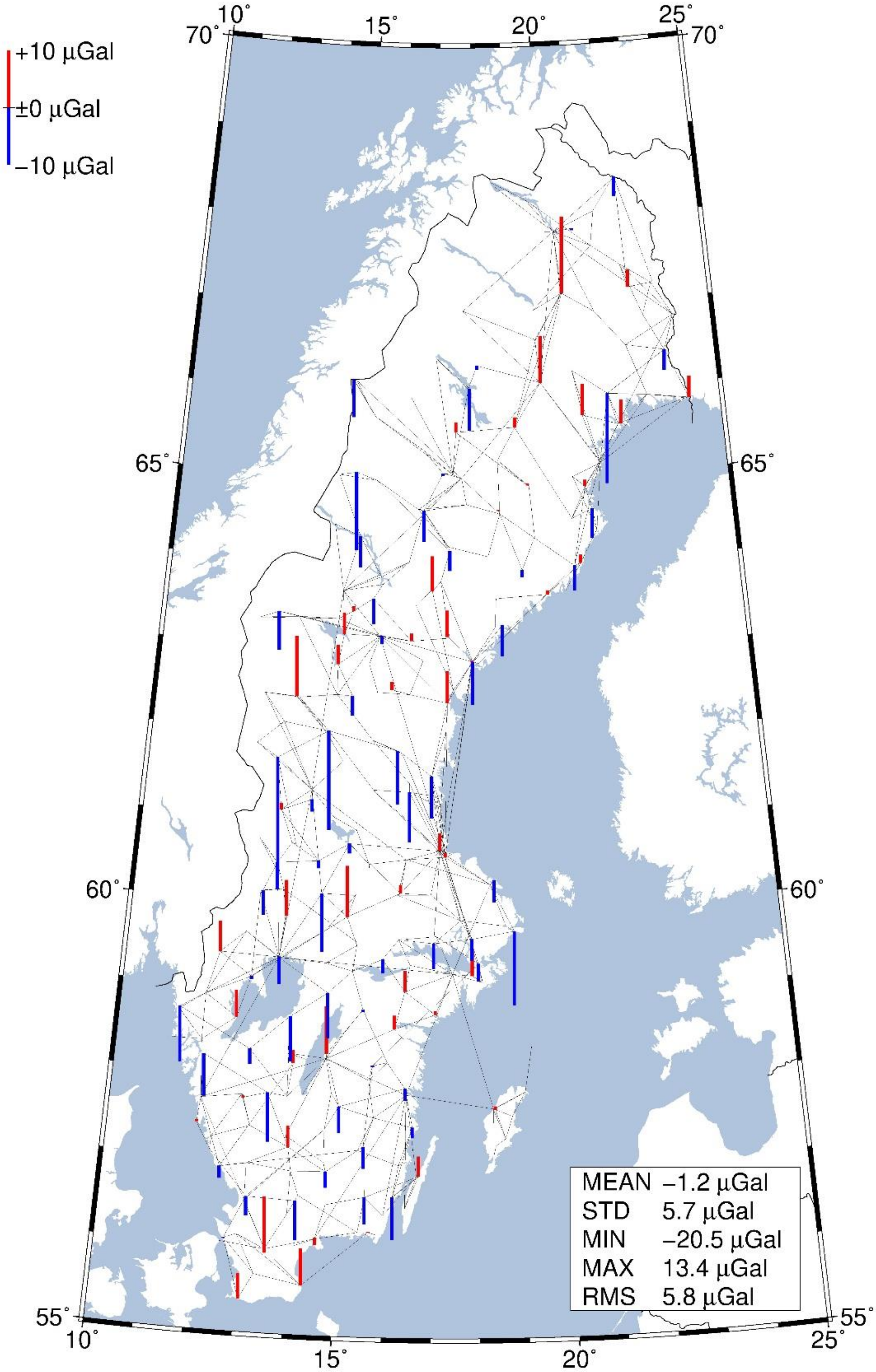

Figure 63: *The residual of the results for the absolute observations. The larger the value, the more the value has changed in the adjustment.*

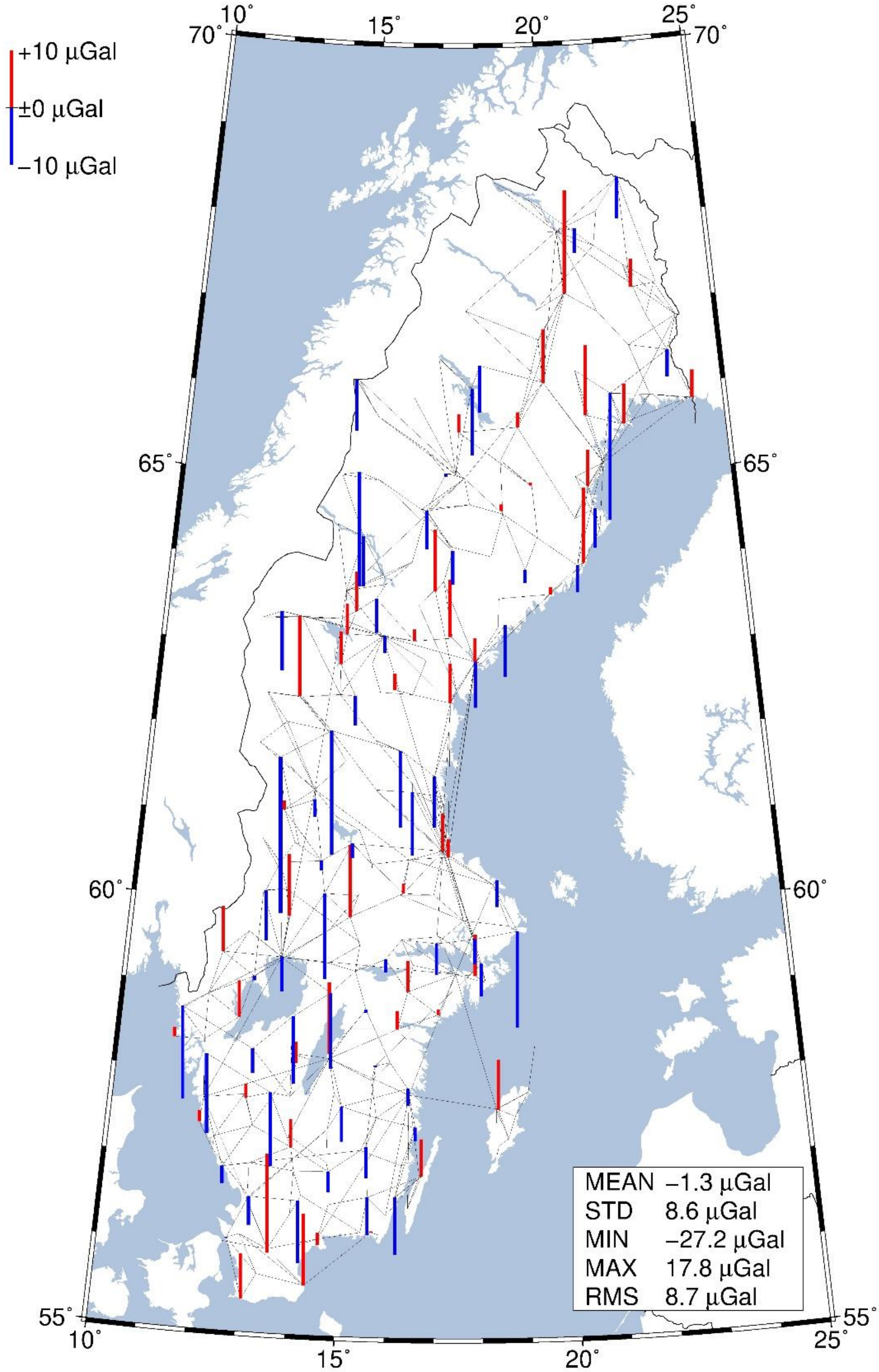

Figure 64: *The result from the leave-one-out cross validation of the absolute observations.*

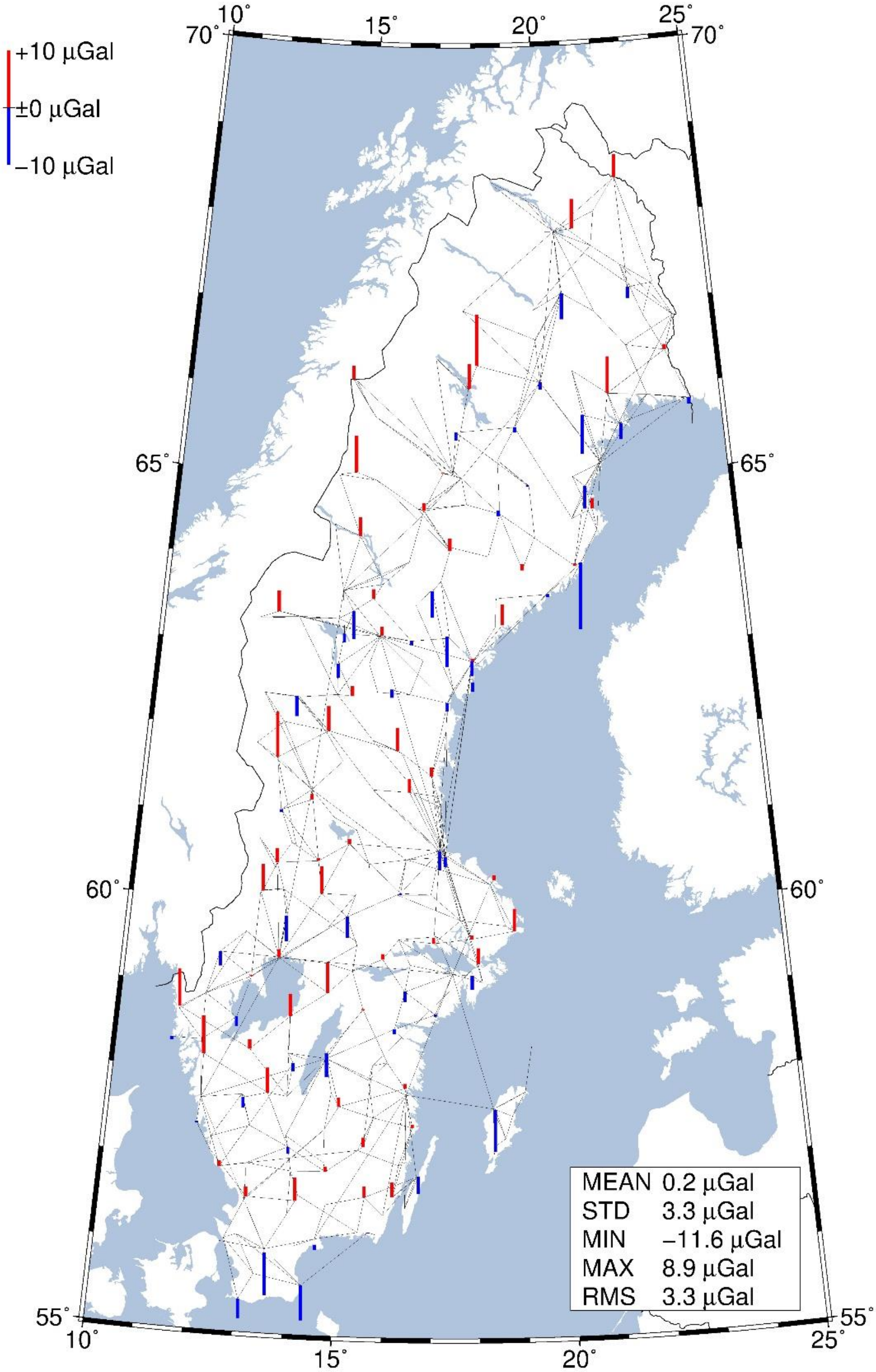

Figure 65: *The difference between the adjusted result and the leave-one-out cross validation. The larger the value, the less the absolute gravity observation and the relative gravity observations correspond to each other.*

Table 9: *The coordinates and the g-values of the points used in the 2019 realization and the g-values of the points*. Column A: Name of the point. Column B: Northing (SWEREF 99 TM). Column C: Easting (SWEREF 99 TM). Column D: Latitude (SWEREF 99, 5 decimals). Column E: Longitude (SWEREF 99 TM, 5 decimals). Column F: Technique for Columns B-E (STAT GNSS = Static GNSS; RTK FIX = Real Time Kinematic Fix; RTK FL = RTK Float; DGNSS = Differential GNSS; RTK HP = Hidden point with RTK Fix; ABS GNSS = Absolute GNSS; EST = Estimated from a map; UNKN = Unknown). Column G: Height (RH 2000). Column H: Technique for Column G (Levelling = The point is either included in RH 2000 or is levelled directly from a point included in RH 2000; Levelling + TF = The point is included in RH 70 or RH 00 and transformed to RH 2000; STAT GNSS = Static GNSS; RTK Fix = The height is measured by RTK Fix; RTK FL = The height is measured with RTK Float; RTK FIX + MS = The height is measured at another point with RTK and measured manually from there; HP = The Northing and Easting is measured with RTK HP and the numbers of the decimals for the height indicate the height quality; ABS GNSS = Absolute GNSS; UNKN = Unknown). Column I: g-value in RG 2000.

A	B	C	D	E	F	G	H	I
Alby (Destroyed)	6930291.988	527701.969	62 30 09.5	15 32 16.0	EST	170.038	Levelling	982038.9379
Algutsboda 1p	6286687.945	535658.061	56 43 22.28579	15 34 57.59095	ABS GNSS	189.6	Levelling + TF	981620.1251
Ammarnäs	7314759.025	556510.589	65 56 55.55773	16 14 33.60370	RTK FL	418.504	Levelling + TF	982198.6635
Aneby	6409305.643	487788.630	57 49 31.93895	14 47 39.87168	ABS GNSS	227.185	Levelling	981669.6328
Arboga AA	6584255.436	547781.274	59 23 39.30553	15 50 28.75364	RTK HP	8.000	HP	981837.7594
Arbrå	6813714.295	573752.640	61 27 00.64991	16 22 59.93067	RTK FIX	106.125	Levelling	981992.3716
Arjeplog	7327841.399	629982.258	66 02 40.06083	17 52 10.89277	RTK FL	427.348	Levelling	982237.3331
Arjeplog AA	7358845.869	639855.985	66 19 04.8	18 07 17.0	EST	454.967	Levelling	982253.5779
Arjeplog AB	7328655.083	631553.123	66 03 03.97184	17 54 18.54345	RTK FL	431.203	Levelling	982237.9081

Arjeplog B	7358864.252	640017.671	66 19 05.13226	18 07 30.04102	ABS GNSS	455.385	Levelling	982253.5154
Arvidsjaur	7281037.358	691653.078	65 35 39.74665	19 09 33.02336	RTK HP	383.955	Levelling	982216.6858
Arvidsjaur AA	7281210.978	692010.077	65 35 44.57735	19 10 01.72140	RTK HP	387.473	HP	982216.6091
Arvidsjaur 1p	7281188.630	691996.586	65 35 43.88628	19 10 00.55527	RTK HP	387	HP	982216.0559
Arvika	6614369.252	370175.111	59 38 49.76493	12 41 47.88405	ABS GNSS	115.766	Levelling	981844.4384
Augerum AA	6230412.184	541892.699	56 13 00.40437	15 40 31.78452	RTK HP	22.168	HP	981614.9962
Avesta	6668136.508	564274.268	60 08 42.44412	16 09 26.79122	RTK FL	96.75	Levelling	981882.6759
Baltak AA	6445674.807	437225.033	58 08 52.50560	13 56 00.79749	RTK FIX	165.145	RTK FIX	981704.7491
Bergnäset	7291559.501	825354.882	65 34 53.37894	22 03 53.78748	RTK FL	14.854	Levelling	982298.8386
Bjurholm AA	7096201.879	709222.150	63 55 47.40997	19 16 9.252746	RTK FIX	233.531	Levelling	982148.0464
Björkliden NA	7591976.162	651671.776	68 23 58.92441	18 41 37.45050	RTK FIX	387.843	RTK FIX	982362.0803
Björkliden NB	7596611.658	647728.632	68 26 35.82678	18 36 16.35339	RTK FIX	377.787	RTK FIX	982365.4843
Björna	7057924.220	676662.871	63 36 18.07005	18 33 46.93761	ABS GNSS	172.033	Levelling	982143.3118
Blomstermåla	6318142.839	578259.379	57 00 00.61343	16 17 17.93488	RTK FIX	42.674	Levelling	981658.9396
Boda	6973871.247	585467.776	62 53 05.31830	16 40 51.08121	ABS GNSS	169.011	Levelling	982087.9303
BodaBruk AA	6823797.865	602277.609	61 32 03.02296	16 55 24.97611	RTK FL	65.942	Levelling	981998.3268
Bofors	6576915.834	474633.897	59 19 49.04450	14 33 15.13890	RTK FIX	110.897	Levelling	981804.5696

Bollnäs AA	6802084.686	574317.958	61 20 44.51978	16 23 21.37465	RTK FIX	61.476	RTK FIX	981994.5704
Borgholm	6304557.697	601769.724	56 52 24.95605	16 40 10.98818	RTK FIX	15.689	Levelling	981650.5050
Borgsjö AA	6934659.880	546640.187	62 32 23.78704	15 54 23.65780	RTK FL	131.5	RTK FL	982062.1957
Borlänge	6707005.379	525397.809	60 29 54.15050	15 27 44.32902	RTK FIX	132.594	Levelling	981907.8745
Borås	6403418.855	372605.342	57 45 17.07653	12 51 32.97529	RTK FIX	292.930	Levelling	981661.2951
Borås AA	6399037.829	374275.684	57 42 57.2	12 53 22.2	EST	176.076	Levelling	981680.0480
Borås 1p	6399642.856	377271.898	57 43 19.73261	12 56 22.02102	RTK HP	142.4	HP	981685.7595
Bottnaryd	6402429.540	430779.170	57 45 30.96955	13 50 12.18028	RTK FIX	211.796	Levelling	981671.5896
Bunge	6419533.533	738711.056	57 51 13.64312	19 01 24.70315	RTK HP	26.019	HP	981699.5470
Bureå 1p	7180421.581	796325.048	64 37 05.67061	21 12 11.66017	RTK HP	11.019	HP	982225.4329
Bureå AA	7180422.403	796318.775	64 37 05.71679	21 12 11.19679	RTK FIX	10.955	RTK FIX	982225.4515
Burträsk	7166045.713	770794.187	64 30 40.62601	20 38 43.32917	DGNSS	93.966	Levelling	982206.1271
Dala	6458566.347	430188.816	58 15 45.45726	13 48 36.66190	RTK FL	155.702	Levelling	981719.7288
Dalby	6172034.178	396389.985	55 40 58.93464	13 21 07.57531	RTK FL	90.026	Levelling	981565.6630
Dals Ed	6532433.471	320883.435	58 53 39.12002	11 53 28.18291	RTK FIX	156.411	Levelling	981775.9000
Duved AA	7031042.143	396536.154	63 23 34.56936	12 55 45.23859	RTK HP	401	HP	982011.8347
Dörby 1p	6281500.674	575561.844	56 40 17.44771	16 13 58.99559	RTK FIX	10.436	RTK FIX	981653.0270

Edefors	7357773.747	762855.546	66 13 45.74572	20 51 03.20649	RTK FL	67.878	Levelling	982340.0001
Ekshärad	6671252.439	415750.825	60 10 10.06161	13 28 54.09527	RTK FIX	180.75	Levelling	981828.0033
Eksjö AA	6391658.768	498292.549	57 40 01.88528	14 58 16.96327	RTK HP	212.25	HP	981672.9194
Emmaboda AA	6275560.002	535628.867	56 37 22.40947	15 34 50.33092	RTK FIX	126.785	Levelling	981630.1414
Enköping	6616410.926	616218.290	59 40 10.18043	17 03 47.78648	ABS GNSS	30.289	Levelling	981856.0478
Eskilstuna	6578019.153	583618.378	59 19 57.63252	16 28 10.98586	RTK FIX	31.1	Levelling	981833.4369
Falkenberg AA	6309292.921	347095.144	56 54 07.47394	12 29 21.21223	RTK FIX	9.437	RTK FIX	981690.6985
Fredrika	7111971.308	664189.410	64 05 42.85438	18 22 10.16892	ABS GNSS	296.487	Levelling	982152.2462
Fredriksberg AA	6667003.102	465555.536	60 08 18.78304	14 22 47.52412	RTK FIX	298.497	Levelling	981841.5967
Fryksände AA	6668402.961	389696.468	60 08 15.66034	13 00 50.34827	RTK HP	105.5	HP	981857.5001
Föllinge A	7060954.935	478706.726	63 40 32.71130	14 34 10.70607	RTK FIX	301.775	Levelling	982075.7178
Föllinge B	7061041.996	478718.189	63 40 35.52650	14 34 11.49743	RTK FIX	301.527	Levelling	982075.6892
Gamleby AA	6417975.358	582933.322	57 53 45.14651	16 23 56.59500	RTK HP	20.144	HP	981728.8081
Garde	6358365.802	715712.736	57 19 01.62197	18 34 56.79268	RTK HP	28.608	HP	981695.0769
Gnarp	6882646.106	618551.162	62 03 26.58491	17 16 04.82265	RTK HP	54.236	Levelling	982030.2486
Gothem	6387594.279	723293.218	57 34 31.70786	18 44 04.84712	RTK HP	13.315	HP	981713.3499
Gotska sandön	6480097.685	744934.310	58 23 34.7	19 11 29.2	EST	11.784	UNKN	981746.1876

Granberget 1p	7137977.573	581944.233	64 21 28.0	16 41 50.0	EST	355.67	Levelling+TF	982119.5372
Grinneröd AA	6453978.255	320997.615	58 11 26.28354	11 57 17.39694	RTK HP	87.905	HP	981740.9272
Grythyttan	6619845.254	473536.540	59 42 56.56547	14 31 46.49571	RTK FIX	199.080	Levelling	981819.9012
Grytnäs AA	6670667.011	567742.911	60 10 02.20575	16 13 14.63068	RTK HP	75.90	HP	981889.4607
Grötlingbo	6337212.630	702516.686	57 08 00.47464	18 20 47.37312	RTK HP	25.098	HP	981654.4228
Gulsele	7077326.408	604394.240	63 48 27.95000	17 07 12.23233	RTK FIX	263.637	Levelling	982138.1203
Gäddede	7147169.559	464697.675	64 26 53.70757	14 15 59.27251	ABS GNSS	325.435	Levelling	982122.7506
Gällivare	7456663.658	744071.237	67 07 39.09815	20 38 00.53359	RTK FIX	365.149	Levelling	982345.2013
Gällivare AA	7457286.183	745146.975	67 07 55.95454	20 39 34.07885	RTK FIX	365.483	RTK FIX	982341.1583
Göteborg A	6397806.197	319848.460	57 41 10.8	11 58 40.8	EST	44.647	Levelling	981718.7069
Göteborg 1p	6400104.620	319142.094	57 42 24.0	11 57 52.0	EST	4	UNKN	981727.0833
Göteborg NB	6397786.201	319768.460	57 41 10.03897	11 58 36.03034	RTK HP	47.573	Levelling	981718.3356
Hakkas	7435867.690	788092.203	66 54 11.96972	21 35 28.32999	ABS GNSS	201.998	Levelling	982356.4407
Hallstahammar	6610529.691	567625.123	59 37 38.71869	16 11 56.37162	ABS GNSS	65.232	Levelling	981838.5543
Hallviken	7070932.848	529715.218	63 45 52.86336	15 36 08.88250	ABS GNSS	303.170	Levelling	982108.1892
Hammerdal AA	7051944.365	518070.924	63 35 42.25044	15 21 51.10882	RTK HP	308.92	HP	982093.8005
Hamrånge 1p	6756402.896	610516.081	60 55 38.09422	17 02 20.08381	RTK HP	21	HP	981965.8941

Haparanda	7328888.598	910902.646	65 48 55.11663	24 00 47.54803	RTK FIX	10.019	Levelling	982321.2006
Haparanda AA	7329785.168	916083.040	65 48 59.64936	24 07 40.56324	STAT GNSS	15.240	STAT GNSS	982326.9085
Hede	6920723.709	427153.956	62 24 38.37117	13 35 24.40292	RTK FL	409.063	Levelling	981948.3203
Hede AA	6921605.716	423398.563	62 25 04.14812	13 31 01.43561	ABS GNSS	420.595	UNKN	981944.6336
Helsingborg AA	6217510.648	355978.967	56 04 51.65499	12 41 08.51734	RTK FIX	44.463	RTK FIX	981608.0568
Helsingör Relative point	6213719.387	349187.332	56 02 41.6	12 34 43.7	EST	32	UNKN	981580.3578
Hemavan	7301843.601	502269.483	65 50 16.45914	15 02 58.87765	RTK FIX	469.696	Levelling	982165.8612
Hemse 1p	6348366.989	703385.015	57 13 59.2	18 22 11.7	UNKN	25.946	UNKN	981677.2531
Hillerstorp	6351598.306	431312.487	57 18 07.82332	13 51 36.05511	RTK HP	167.358	Levelling	981643.2387
Hofors A	6714834.282	573008.611	60 33 46.2	16 19 54.0	EST	184.358	Levelling+TF	981908.1613
Hofors B	6714466.184	573198.600	60 33 34.18088	16 20 05.98096	RTK FIX	192.358	Levelling+TF	981908.1730
Holmsund AA	7071788.651	766418.684	63 40 21.87731	20 23 19.76775	RTK HP	6	HP	982171.1376
Hoting	7100626.932	562327.003	64 01 36.56473	16 16 31.98546	ABS GNSS	250.053	Levelling	982143.6269
Hundsjön AA	7330425.043	810062.072	65 56 33.94302	21 49 37.59823	RTK FIX	28.219	Levelling	982329.5476
Husby-Ärlinghundra AA	6614854.363	662467.323	59 38 24.24021	17 52 55.62284	RTK HP	22.367	HP	981848.3575
Hybo	6852162.214	562963.226	61 47 49.77609	16 11 39.21183	RTK HP	130.122	Levelling	982020.3657
Hällnäs	7140561.509	723495.213	64 19 04.00915	19 37 30.06235	RTK FL	259.690	Levelling	982165.3851

Härnösand AA	6947938.854	650820.130	62 37 52.32857	17 56 28.51765	RTK FIX	16.526	RTK FIX	982070.4243
Hörnefors AA	7066150.040	743151.334	63 38 20.91219	19 54 41.87877	RTK FL	11.791	Levelling	982150.8465
Hörnefors 1p	7064119.849	743355.289	63 37 15.05590	19 54 45.32598	RTK FIX	4.815	RTK FIX	982149.8925
Höör A	6205068.768	409515.293	55 58 56.6	13 32 59.2	EST	140.302	Levelling	981580.4164
Höör AA	6199368.249	409392.324	55 55 52.18656	13 32 59.00503	RTK HP	72.2	HP	981588.7350
Höör B	6204455.988	409242.330	55 58 36.6	13 32 44.2	EST	141.950	Levelling	981580.4149
Idre	6860002.296	374812.945	61 51 07.75838	12 37 15.73280	RTK FL	548.570	Levelling	981885.2978
Johannishus	6230134.096	528143.684	56 12 55.05255	15 27 13.61150	RTK FL	34.477	Levelling	981612.1312
Jokkmokk	7395748.084	713476.710	66 36 22.81684	19 49 19.52087	RTK HP	260.106	Levelling	982347.3358
Jokkmokk 1p	7395677.682	714352.667	66 36 18.36431	19 50 29.99749	RTK HP	251.738	HP	982346.9184
Jordbro	6559122.319	678481.906	59 08 01.65808	18 07 10.00872	RTK FIX	52.176	Levelling	981822.8467
Jukkasjärvi NA	7536530.501	731121.504	67 51 03.43578	20 29 57.54752	ABS GNSS	347.452	Levelling	982361.8541
Jukkasjärvi NB	7536718.466	730814.270	67 51 10.35734	20 29 32.80578	ABS GNSS	348.610	Levelling	982362.0900
Junosuando	7498249.600	818411.257	67 25 41.12248	22 26 54.03071	RTK FL	219.917	Levelling	982397.6044
Junsele AA	7064119.651	593948.543	63 41 32.14981	16 54 0.37618	RTK FIX	232.738	RTK FIX	982143.9205
Jäkkvik	7366270.232	586837.182	66 24 13.67768	16 56 39.55375	ABS GNSS	431.536	Levelling	982242.1821
Jämjö 1p	6227773.314	551640.175	56 11 31.61120	15 49 55.69567	RTK HP	21.5	HP	981611.9175

Järpen	7025363.508	422692.948	63 20 55.01904	13 27 18.78123	RTK FIX	333.705	Levelling	982027.9634
Jävre NA	7242096.779	803946.566	65 09 41.07191	21 29 37.05895	RTK FL	30.221	Levelling	982269.2836
Jävre NB	7239875.175	804614.965	65 08 27.55490	21 30 10.52958	RTK FIX	28.693	Levelling	982268.7586
Jönköping 1p	6404762.682	450023.655	57 46 55.60817	14 09 34.53827	RTK HP	99	HP	981705.8085
Kalix	7331283.151	861488.030	65 53 46.42060	22 56 58.06235	ABS GNSS	24.328	Levelling	982316.5531
Karesuando	7607173.330	802973.380	68 24 48.45568	22 23 39.08522	RTK FIX	333.314	Levelling	982424.9332
Karesuando AA	7610735.982	806134.426	68 26 30.23196	22 28 51.71665	RTK HP	330.030	RTK FIX	982428.1794
Karlstad AA	6582531.949	413635.468	59 22 21.48267	13 28 48.80476	RTK FIX	54.446	Levelling	981827.9068
Karlstad NA	6581987.120	413448.281	59 22 03.73717	13 28 37.74054	RTK FL	54.110	Levelling	981828.1083
Kastlösa	6263351.146	588349.348	56 30 22.56299	16 26 07.67364	ABS GNSS	47.852	Levelling	981624.3996
Kiruna AA	7541694.767	754342.327	67 52 39.4	21 03 36.7	EST	466.593	Levelling	982337.1849
Kiruna A 1p	7535667.986	719933.090	67 51 07.0	20 13 58.0	EST	520	UNKN	982315.3467
Kisa	6426932.944	535636.799	57 58 57.39483	15 36 09.39713	RTK FIX	107.757	Levelling	981720.3710
Klimpfjäll AA	7214916.780	489867.253	65 03 28.18378	14 47 04.77560	RTK FL	582.961	Levelling	982087.8905
Klöveskog AA	6502934.712	361621.634	58 38 40.43825	12 36 56.26778	RTK FIX	67.289	RTK FIX	981770.5695
Korpilombolo	7434406.324	851499.338	66 49 25.66839	23 01 18.10868	RTK FIX	190.515	Levelling	982345.5563
Kramfors A	6973073.607	657372.899	62 51 13.45686	18 05 32.38443	ABS GNSS	95.254	Levelling	982076.5821

Kramfors AA	6975112.461	648892.414	62 52 32.05	17 55 40.00	EST	122.824	Levelling	982075.4084
Kramfors B	6973041.004	657419.099	62 51 12.33324	18 05 35.53612	ABS GNSS	92.823	Levelling	982077.0361
Kramfors C	6974769.728	649403.826	62 52 20.23779	17 56 15.03947	ABS GNSS	118.785	Levelling	982075.5143
Kramfors D/AB	6974786.565	649428.484	62 52 20.74477	17 56 16.83646	ABS GNSS	117.865	Levelling	982075.7225
Kristianstad 1p	6209951.149	447179.623	56 01 54.74702	14 09 08.54430	RTK HP	4.33	HP	981591.2853
Krokom	7024351.190	473713.522	63 20 48.92924	14 28 29.26812	RTK FIX	304.659	Levelling	982048.4801
Kvikkjokk NA	7428586.498	618657.067	66 57 06.17162	17 42 59.97881	RTK FIX	310.699	Levelling	982269.0627
Kvikkjokk NB	7428667.323	618685.430	66 57 08.73890	17 43 02.60390	RTK FIX	312.667	Levelling	982268.7201
Kåbdalis 1p	7345571.604	724843.288	66 08 59.48608	19 59 14.86138	ABS GNSS	355	ABS GNSS	982271.1726
Kåbdalis NA/AA	7340504.483	722349.819	66 06 22.80544	19 55 24.91979	RTK FIX	350.877	Levelling	982270.3848
Kåbdalis NB	7342571.350	718402.115	66 07 39.23874	19 50 24.30914	RTK FIX	346.661	Levelling	982268.8918
Kärda AA	6337116.934	434598.510	57 10 21.32593	13 55 06.08215	RTK HP	179.337	HP	981625.5729
Köpingsvik AA	6305127.375	604723.652	56 52 41.00681	16 43 06.21798	RTK HP	11.871	HP	981650.0970
Laforsen	6868026.006	524385.954	61 56 38.30341	15 27 53.03621	RTK FL	216.454	Levelling	982011.0248
Lagan	6306209.305	439185.851	56 53 44.18520	14 00 06.05627	ABS GNSS	141.440	Levelling	981612.4497
Laholm	6267036.782	380760.861	56 31 57.18288	13 03 40.47518	ABS GNSS	43.700	Levelling	981652.9954
Lansån	7394252.127	830733.596	66 29 23.52227	22 26 38.87001	RTK FIX	81.387	Levelling	982349.8332

Laxå AA	6538149.565	478474.824	58 58 56.54402	14 37 31.90257	RTK FIX	104.944	Levelling	981787.1001
Leksand AA	6732818.616	499044.321	60 43 51.373	14 58 56.922	RTK FIX.	176.902	RTK FIX	981907.8046
Lidträsk	7220442.226	769485.727	64 59 52.95180	20 43 13.39357	RTK FIX	223.080	Levelling	982203.0628
Lindesberg	6601125.603	513678.750	59 32 53.64003	15 14 31.00673	ABS GNSS	65.547	Levelling	981835.2938
Lindesberg 1p	6605933.223	512761.449	59 35 29.16138	15 13 33.63851	RTK FIX	71.449	RTK FIX	981831.5292
Ljungbyholm AA	6277083.310	571686.560	56 37 56.80523	16 10 06.97029	RTK HP	15.657	HP	981653.5586
Ljusdal AA	6855523.749	556468.541	61 49 42.04671	16 04 19.62872	RTK FIX	135.065	RTK FIX	982021.0283
Ljusfallshammar AA	6518046.745	524930.368	58 48 05.95549	15 25 53.23691	ABS GNSS	101.891	Levelling	981785.3030
Ljusnarsberg AA	6637723.703	499876.766	59 52 37.54304	14 59 52.07561	RTK FIX	174.040	RTK FIX	981836.7972
LMV AA	6727518.063	616470.991	60 39 59.30000	17 07 53.00000	EST	13.780	Levelling	981935.1832
LMV Pol 7	6727422.260	616541.232	60 39 55.83197	17 07 57.41893	STAT GNSS	18.029	RTK FIX	981934.5159
Lofsdalen	6888202.499	408641.188	62 06 53.25990	13 14 56.43873	RTK FIX	607.777	Levelling	981893.7447
Ludvika	6665900.476	509074.558	60 07 48.00395	15 09 47.99845	ABS GNSS	182.434	Levelling	981867.3896
Ludvika 1p	6668508.628	510447.919	60 09 12.19305	15 11 17.46814	RTK HP	160.977	Levelling + TF	981876.3429
Luleå AA	7292126.706	829171.915	65 34 57.67000	22 8 54.380241	RTK HP	14.906	HP	982295.4723
Lycksele A	7168037.412	677099.084	64 35 27.44566	18 42 02.53885	RTK FL	218.881	Levelling	982191.0657
Lycksele AA	7171937.146	675211.705	64 37 36.70	18 39 57.85	EST	218.778	Levelling	982196.7412

Lycksele C	7167986.615	677080.474	64 35 25.84317	18 42 00.91978	RTK FIX	218.560	Levelling	982191.0793
Lycksele D	7171933.079	675207.091	64 37 36.57749	18 39 57.48560	RTK FIX	218.473	Levelling	982196.8267
Lönneberga	6378577.157	543592.212	57 32 51.31082	15 43 41.99286	RTK FIX	118.707	Levelling	981680.7687
Lövånger	7153483.274	803918.162	64 22 16.51066	21 18 18.75615	RTK FIX	6.285	Levelling	982223.1986
Maglarp AA	6139052.835	377694.122	55 22 56.99671	13 04 10.17888	RTK FIX	14.398	RTK FIX	981521.7554
Malung	6731623.698	424749.751	60 42 47.22576	13 37 15.73397	RTK FIX	307.490	Levelling	981840.6592
Malung 1p	6726503.450	430700.823	60 40 05.64761	13 43 54.72717	RTK HP	302	HP	981845.7091
Malå	7237549.868	671279.902	65 12 59.16617	18 39 48.31342	RTK HP	315.318	Levelling	982217.3571
Mariestad AA	6506181.455	431098.832	58 41 25.18388	13 48 40.82387	RTK FIX	66.759	Levelling	981774.0185
Misterhult AA	6367778.858	594265.463	57 26 34.45891	16 34 13.92780	ABS GNSS	14.053	Levelling	981682.8746
Mora (Destroyed)	6766227.779	478071.158	61 01 49.0	14 35 39.0	EST	184.696	Levelling	981926.1518
Motala	6492523.839	505416.323	58 34 23.22601	15 05 35.25038	RTK FL	96.079	Levelling	981760.2701
Munkfors AA	6636241.965	421280.547	59 51 22.65589	13 35 40.96578	RTK FIX	157.939	Levelling	981826.7445
Mårtsbo AA	6719817.009	623694.699	60 35 42.47385	17 15 31.04694	RTK FIX	43.695	Levelling	981923.4355
Mårtsbo AB	6719816.992	623693.038	60 35 42.47514	17 15 30.93781	RTK FIX	43.695	Levelling	981923.4414
Mårtsbo B	6719827.118	623660.929	60 35 42.83781	17 15 28.85190	RTK FIX	43.219	Levelling	981923.5969
Mönsterås 1p	6323084.620	587766.406	57 02 34.23245	16 26 47.36457	RTK HP	7.730	HP	981666.9924

Norra Ny 1p	6697872.866	404828.597	60 24 21.50941	13 16 20.61887	RTK FIX	149.735	RTK FIX	981843.1631
Norra Råda 1p	6652715.906	421808.548	60 00 15.38936	13 35 52.46872	RTK HP	142	HP	981831.7424
Norrköping AA	6494289.119	566344.071	58 35 02.19368	16 08 27.84334	RTK FIX	32.377	Levelling	981789.0414
Norrtälje	6633603.926	705699.938	59 47 20.44638	18 39 56.80847	RTK FIX	17.262	Levelling	981857.3908
Norrtälje AA	6627318.016	716905.161	59 43 37.15	18 51 30.40	EST	4.281	Levelling	981860.3581
Norsjö	7206138.856	713301.341	64 54 39.36703	19 30 40.43195	RTK FIX	304.426	Levelling	982190.2033
Norsjö AA	7206422.030	711618.362	64 54 52.34372	19 28 34.29158	RTK HP	310.055	HP	982191.1190
Nyköping AA	6515140.306	618537.637	58 45 35.97497	17 02 57.10641	RTK FIX	27.575	Levelling	981801.2021
Nysätra 1p	7142254.795	792092.124	64 16 52.89872	21 02 22.13361	RTK HP*	20.637	HP	982216.4130
Onsala A	6365571.791	315246.797	57 23 43.7	11 55 31.4	EST	6.852	Levelling	981716.5199
Onsala AA	6365698.624	315276.903	57 23 47.35	11 55 32.90	EST	7.930	Levelling	981716.2944
Onsala AC	6365697.735	315276.027	57 23 47.32	11 55 32.85	EST	7.930	Levelling	981716.3105
Onsala AN	6365584.952	315236.316	57 23 43.62	11 55 30.77	EST	6.143	Levelling	981716.6022
Onsala AS	6365584.319	315236.621	57 23 43.60	11 55 30.80	EST	6.143	Levelling	981716.6084
Onsala B	6365609.115	315945.605	57 23 45.43475	11 56 13.13914	ABS GNSS	2.418	Levelling	981716.3875
Osby	6250288.055	436351.839	56 23 34.48491	13 58 08.27391	RTK FIX	87.669	Levelling	981589.5336
Pajala	7476730.797	859786.636	67 11 23.52417	23 20 13.37788	ABS GNSS	186.676	Levelling	982372.8048

Pajala 1p	7479142.294	861568.762	67 12 32.85575	23 23 07.06771	RTK FIX	174.728	RTK FIX	982379.2599
Pello NA	7436655.184	889910.226	66 47 49.80027	23 53 35.69574	ABS GNSS	93.209	Levelling	982362.3950
Pello NB	7437385.836	889990.963	66 48 12.74182	23 53 50.73221	ABS GNSS	80.755	Levelling	982365.5136
Pello 1p	7437992.605	893715.288	66 48 14.91863	23 58 59.16450	RTK HP	89.62	HP	982366.7427
Porjus	7433672.968	709441.789	66 56 53.30949	19 47 49.64235	ABS GNSS	378.339	Levelling	982319.7703
Ragunda AA	6998590.057	569180.367	63 06 36.21350	16 22 15.68453	RTK HP	167.285	RTK FIX	982129.1810
Ramsele	7045273.526	573209.451	63 31 41.18648	16 28 19.47876	RTK FL	201.804	Levelling	982129.9128
Ratan AA	7108990.260	784534.481	63 59 26.71019	20 49 17.41228	RTK HP	49.619	Levelling	982188.9973
Ratan B	7108984.208	784527.048	63 59 26.53758	20 49 16.82761	RTK FIX	49.955	Levelling	982188.9327
Rimforsa AA	6446198.453	540029.859	58 09 18.95744	15 40 48.62058	RTK FL	88.179	Levelling	981738.8511
Rätansbyn	6925688.787	475813.267	62 27 41.64549	14 31 51.99261	ABS GNSS	371.356	Levelling	982013.4732
Rättvik (Destroyed)	6750687.251	507767.981	60 53 28.64202	15 08 35.28374	RTK FL	177.456	Levelling	981923.1949
Saxnäs	7205185.949	517038.901	64 58 12.84547	15 21 39.33148	RTK FIX	548.762	Levelling	982093.8243
Simrishamn AA	6159165.048	458013.591	55 34 35.94838	14 20 02.57804	RTK FIX	13.146	Levelling	981566.9721
Skellefteå AA	7208703.838	786176.589	64 52 45.70	21 02 54.95	EST	56.300	Levelling	982230.3944
Skellefteå B	7208717.153	786169.358	64 52 46.15	21 02 54.50	EST	55.393	Levelling	982230.5827
Skutskär 1p	6724341.203	632063.844	60 37 58.97563	17 24 51.55133	RTK HP	8.700	HP	981934.5809

Skönberga 1p	6481319.822	579240.826	58 27 55.20425	16 21 29.90303	RTK HP	42.97	Levelling+TF	981780.3171
Smögen AA	6474291.131	278726.581	58 21 12.69832	11 13 04.66435	RTK HP	5.789	HP	981770.1918
Sollefteå	7004241.955	618427.291	63 08 52.64876	17 21 01.16386	ABS GNSS	87.318	Levelling	982115.6375
Sollefteå AA	7005710.279	615021.411	63 09 44.02160	17 17 01.79134	RTK FL	53.259	RTK FIX	982123.6718
Solna	6583346.025	671788.099	59 21 13.62569	18 01 18.55667	RTK FIX	15.586	Levelling	981829.1070
Solna AA	6583255.713	671916.023	59 21 10.52246	18 01 26.38492	RTK FL	14.516	RTK FIX	981829.2030
Soppero	7565627.347	781094.783	68 03 57.99375	21 45 16.26800	RTK FIX	376.801	Levelling	982375.7849
Sorsele	7270863.832	621936.837	65 32 13.27619	17 38 22.16332	ABS GNSS	412.103	Levelling	982217.4598
Sorsele AA	7271165.071	616160.295	65 32 30.63289	17 30 53.49409	RTK HP	345.871	RTK FIX	982219.0114
Stavre	6966831.626	515840.290	62 49 52.68018	15 18 39.35662	ABS GNSS	302.339	Levelling	982038.9967
Stavreviken	6937004.471	626098.771	62 32 32.75635	17 27 05.86406	RTK FL	17.910	Levelling	982082.3273
Stekenjokk	7211322.350	468112.337	65 01 27.11964	14 19 23.41389	ABS GNSS	721.589	Levelling	982065.2827
Stenbrohult 1p	6275062.643	449812.096	56 37 01.52639	14 10 55.92837	ABS GNSS	143.02	Levelling + TF	981595.4070
Stensele A	7211938.405	625859.280	65 00 26.64617	17 40 13.15597	RTK FIX	285.243	Levelling	982191.1285
Stensele AA	7217475.440	601809.090	65 03 55.05186	17 09 52.45367	RTK HP	332.596	RTK FIX	982174.7410
Stensele B	7216548.349	614326.076	65 03 10.43464	17 25 46.78555	RTK FIX	338.083	RTK FIX	982191.1962
Stensele B 1p	7217485.307	601784.457	65 03 55.39759	17 09 50.59572	RTK FIX	331.896	RTK FIX	982174.8873

Stora Tuna 1p	6701828.285	526130.167	60 27 06.64836	15 28 29.87173	RTK HP	129.450	HP	981907.2377
Ström 1p	7080504.607	527350.948	63 51 02.77871	15 33 22.41278	RTK FL	297.230	Levelling+TF	982108.2604
Strömsund	7245965.276	576081.426	65 19 39.80779	16 38 00.81262	RTK FIX	353.833	Levelling	982178.1062
Stugun A	7003334.544	528228.743	63 09 29.38382	15 33 37.22552	RTK FIX	273.466	Levelling	982076.4158
Stugun AA	7004266.177	531023.189	63 09 58.65654	15 36 57.54199	RTK HP	223.514	RTK FIX	982088.0588
Stugun B	7003373.199	528321.453	63 09 30.60652	15 33 43.87441	RTK FIX	277.934	Levelling	982075.6696
Stugun C	7003110.770	528106.751	63 09 22.18826	15 33 28.36958	RTK FIX	277.414	Levelling	982075.6080
Stugun D	7003109.378	528101.300	63 09 22.14482	15 33 27.97918	RTK FIX	276.114	Levelling	982075.8874
Stöllet AA	6704991.860	406704.451	60 28 13.09114	13 18 11.15909	RTK FIX	299.529	Levelling	981819.8786
Sundsvall AA	6919881.503	618874.786	62 23 28.50850	17 17 58.11437	RTK HP	16.000	HP	982069.8753
Sundsvall 1p	6919884.098	618875.327	62 23 28.59166	17 17 58.15839	RTK HP	16.000	HP	982069.8809
Sved AA	7132045.799	498132.357	64 18 51.70590	14 57 40.97497	ABS GNSS	358.516	Levelling	982086.2416
Sveg	6875261.063	464453.316	62 00 28.92138	14 19 16.12685	RTK FL	375.782	Levelling	981957.8940
Sveg AA	6878134.391	466607.303	62 02 02.47509	14 21 42.26122	RTK FIX	359.210	RTK FIX	981967.7293
Svenljunga	6363092.994	384253.062	57 23 45.13749	13 04 26.35211	RTK FIX	140.719	Levelling	981666.0451
Svenstavik AA	6964987.355	475406.927	62 48 51.34783	14 31 03.12435	ABS GNSS	313.041	Levelling	982030.8042
Svinnegarn AA	6607243.294	612985.960	59 35 17.2	17 00 03.7	EST	9.250	RTK FIX	981848.0897

Sysslebäck	6735909.581	382931.939	60 44 29.41238	12 51 09.63545	ABS GNSS	178.911	Levelling	981864.0487
Säffle AA	6556081.429	378823.591	59 07 36.09476	12 52 58.17023	RTK FIX	73.812	Levelling	981817.0547
Särna	6841880.833	396594.999	61 41 46.0	13 02 42.0	EST	475.308	Levelling	981897.1198
Särna AA	6841596.753	401715.167	61 41 41.67134	13 08 30.82066	RTK FIX	427.599	RTK FIX	981906.9995
Särna 1p	6841515.091	401605.205	61 41 38.93213	13 08 23.50023	RTK FIX	433.000	RTK FIX	981905.9362
Sävar AA	7105014.344	776739.538	63 57 41.53323	20 39 20.78472	RTK FIX	54.596	Levelling	982191.0301
Sävar B	7105170.497	776834.541	63 57 46.28161	20 39 28.75018	RTK FIX	54.952	Levelling	982191.0052
Sävsjö	6361421.991	480836.593	57 23 42.65331	14 40 52.15428	RTK FIX	235.288	Levelling	981655.0650
Söderhamn 1p	6798347.561	609817.032	61 18 13.58435	17 03 00.94745	RTK HP	19.320	HP	981993.2941
Södertälje NA	6568315.936	638839.005	59 13 51.85029	17 25 59.75226	ABS GNSS	19.691	Levelling	981828.0847
Södertälje NB	6569984.518	639586.938	59 14 44.86044	17 26 50.75426	RTK FIX	27.096	RTK FIX	981827.9854
Södra Fågelås 1p	6451355.558	453533.796	58 12 03.42655	14 12 34.01087	ABS GNSS	117.000	UNKN	981704.6647
Sölvesborg A	6219470.724	473272.971	56 07 10.45044	14 34 12.47354	ABS GNSS	98.128	Levelling	981580.4148
Sölvesborg AA	6212072.037	474137.399	56 03 11.315	14 35 05.100	EST	8.677	RTK FIX	981593.8518
Sölvesborg B	6220060.382	473078.410	56 07 29.48314	14 34 00.99431	ABS GNSS	100.674	Levelling	981580.4199
Tandsjöborg	6839369.050	486888.836	61 41 14.22301	14 45 07.97029	ABS GNSS	462.839	Levelling	981916.2386
Tanum	6511363.338	287187.890	58 41 23.97493	11 19 39.48978	EST	37.474	Levelling	981786.1517

Tanum AA	6514248.599	287652.036	58 42 57.89003	11 19 58.46296	RTK HP	45.595	HP	981785.7334
Tingstäde 1p	6405099.799	715080.652	57 44 11.0	18 36 47.6	UNKN	52.169	UNKN	981711.1396
Torneträsk	7575728.477	693227.591	68 13 44.75173	19 40 19.51887	RTK FIX	365.670	Levelling	982378.7120
Torpshammar	6928992.039	569889.892	62 29 07.51671	16 21 21.78206	RTK FIX	124.528	Levelling	982068.4823
Torsby	6667246.858	386637.028	60 07 35.30	12 57 34.50	EST	106.083	Levelling	981856.1275
Torsås	6253077.623	560189.937	56 25 06.32742	15 58 32.39647	RTK FL	20.314	Levelling	981641.3444
Torup	6314698.890	381700.664	56 57 38.64045	13 03 16.25296	ABS GNSS	108.099	Levelling	981676.6156
Transtrand	6774296.644	409461.305	61 05 34.44564	13 19 15.54585	RTK FIX	371.511	Levelling	981865.6817
Transtrand AA	6773783.939	409009.315	61 05 17.50658	13 18 46.26797	RTK FIX	357.897	RTK FIX	981867.0820
Tullinge AA	6567260.426	664526.596	59 12 44.67942	17 52 55.38875	RTK HP	42.592	RTK FIX	981827.1619
Turinge 1p	6564430.819	639427.832	59 11 45.66560	17 26 27.89627	RTK HP	20.50	HP	981826.5811
Tännäs	6925277.568	382087.920	62 26 23.83867	12 42 55.58791	RTK FIX	588.528	Levelling	981907.1981
Tärendö AA	7469164.792	830120.138	67 09 24.24805	22 38 09.76444	RTK HP	175.493	RTK FIX	982387.1311
Tärnaby	7287674.273	512056.263	65 42 38.02344	15 15 45.58383	RTK FIX	451.833	Levelling	982153.9043
Tärnsjö	6670066.239	607118.201	60 09 12.44459	16 55 46.47178	RTK FIX	79.299	Levelling	981900.8304
Uddevalla	6472667.510	317738.257	58 21 24.89182	11 53 05.22428	ABS GNSS	37.765	Levelling	981760.2052
Ulricehamn AA	6406529.081	405631.558	57 47 26.98549	13 24 45.53121	RTK HP	183.536	HP	981681.2708

Umbukta A	7333457.391	485916.223	66 07 16.41378	14 41 17.55985	RTK FIX	542.524	Levelling	982191.1412
Umbukta AA	7335023.899	481536.377	66 08 06.19300	14 35 27.69231	RTK FIX	526.516	RTK FIX	982201.9146
Umbukta B	7333398.718	485982.380	66 07 14.52943	14 41 22.85553	RTK FIX	540.337	Levelling	982191.2943
Uppsala	6638390.918	646820.228	59 51 25.19668	17 37 17.00442	RTK FIX	22.464	Levelling	981883.6616
Uppsala C 1p	6638476.284	646861.952	59 51 27.90	17 37 19.90	EST	20.114	Levelling + TF	981883.8062
Urshult	6264395.622	485807.562	56 31 25.42756	14 46 09.51625	RTK FIX	144.521	Levelling	981594.5976
Valla AA	6543480.391	578251.737	59 01 25.03793	16 21 46.88451	RTK FIX	52.817	Levelling	981816.5343
Vallvik	6784294.196	615695.947	61 10 33.58880	17 09 04.67689	RTK FIX	12.790	Levelling	981987.8364
Vansbro AA	6709010.792	459777.304	60 30 54.61877	14 16 02.80340	ABS GNSS	246.433	Levelling	981861.8193
Vara AA	6462352.454	380333.337	58 17 09.17604	12 57 32.45498	RTK FIX	80.155	Levelling	981752.3302
Varberg 1p	6331106.435	333476.044	57 05 35.24554	12 15 05.29087	RTK FIX	40.300	RTK FIX	981694.8420
Vassijaure 1p	7594316.972	633644.963	68 25 47.18287	18 15 31.22417	RTK FIX	514.160	RTK FIX	982341.5725
Veddige	6347758.874	334965.540	57 14 35.09946	12 15 54.01419	ABS GNSS	15.950	Levelling	981696.0552
Veinge AA	6271351.519	382798.609	56 34 18.50080	13 05 32.66280	RTK HP	41.307	RTK FIX	981656.2500
Vilhelmina	7169781.223	571874.141	64 38 43.19516	16 30 15.66389	ABS GNSS	343.296	Levelling	982144.0586
Vilhelmina AA	7168209.586	578644.790	64 37 47.01347	16 38 42.51166	RTK FIX	401.031	RTK FIX	982131.8182
Vinliden	7178043.836	633689.001	64 42 02.07530	17 48 15.71066	RTK HP	410.672	Levelling	982151.7108

Virserum AA	6340614.170	531571.961	57 12 27.28727	15 31 21.49527	RTK FIX	206.299	Levelling	981647.0934
Visby AA	6395167.477	700906.161	57 39 13.62	18 22 02.60	EST	52.511	Levelling	981714.3953
Visby D	6395181.494	701188.372	57 39 13.89	18 22 02.61	EST	52.098	Levelling	981714.5343
Visby NA	6396163.897	698510.911	57 39 49.98775	18 19 41.00344	ABS GNSS	42.450	Levelling	981719.2348
Visby NB	6395402.061	698128.207	57 39 26.0	18 19 15.7	UNKN	40.303	Levelling	981718.5397
Vittangi	7520811.723	779729.307	67 40 05.47123	21 36 26.60618	RTK FIX	269.482	Levelling	982402.8911
Vittangi 1p	7521884.919	781365.994	67 40 34.25134	21 38 54.38553	RTK FIX	254.224	RTK FIX	982405.5138
Vittangi 2p	7521881.814	781366.501	67 40 34.15	21 38 54.40	EST	254.715	RTK FIX + MS	982405.3799
Voxna	6800293.057	530212.301	61 20 07.95034	15 33 52.44867	RTK FL	197.210	Levelling	981967.4455
Voxna AA	6803589.681	527506.642	61 21 55.21105	15 30 52.18961	RTK FIX	200.187	RTK FIX	981970.0637
Västervik NA	6409691.919	584871.342	57 49 16.06445	16 25 43.63019	ABS GNSS	31.012	Levelling	981718.5402
Västervik NB	6410384.225	588520.050	57 49 35.9	16 29 25.6	EST	18.000	UNKN	981718.4177
Västra Tollstad AA	6459681.039	479799.922	58 16 39.76390	14 39 20.11269	RTK FIX	104.480	RTK FIX	981725.6194
Åmot	6760214.295	579957.873	60 58 07.71097	16 28 37.16389	RTK FIX	210.794	Levelling	981935.3154
Ånn	7022427.648	372089.459	63 18 27.98972	12 26 50.41239	RTK FIX	544.590	Levelling	981998.5916
Årjäng AA	6586990.540	337134.635	59 23 24.04364	12 07 55.70223	RTK FIX	116.634	Levelling	981819.3803
Åseda	6335889.770	524682.618	57 09 56.02805	15 24 29.26069	ABS GNSS	233.233	Levelling	981638.7306

Åsele	7122422.424	612519.536	64 12 34.61406	17 19 05.56558	ABS GNSS	317.119	Levelling	982139.8243
Åsele AA	7117367.572	614482.221	64 09 49.12262	17 21 17.12577	RTK FIX	336.487	RTK FIX	982140.5749
Åstorp	6222628.757	372416.857	56 07 53.89684	12 56 49.90030	RTK FIX	46.044	Levelling	981617.3635
Åte	7020374.441	676907.572	63 16 06.75758	18 31 34.73296	ABS GNSS	34.596	Levelling	982122.3313
Åtvidaberg	6450767.259	558863.686	58 11 39.07958	16 00 04.66297	RTK FIX	93.102	Levelling	981736.7548
Älmhult AA	6267978.806	446450.377	56 33 11.10315	14 07 44.02481	RTK HP	145.547	HP	981588.8860
Älvdalen A	6801093.468	447761.277	61 20 25.41713	14 01 25.18026	RTK FIX	346.023	Levelling	981908.1486
Älvdalen AA	6788353.957	448514.829	61 13 34.107	14 02 28.452	RTK FIX.	242.484	RTK FIX	981920.2416
Älvdalen B	6802217.290	447630.802	61 21 01.66929	14 01 15.26908	RTK FIX	349.883	Levelling	981908.1503
Älvsbyn	7296926.718	780296.570	65 40 17.62295	21 06 18.30822	RTK FL	66.900	Levelling	982299.3062
Älvsbyn AA	7300707.562	778612.674	65 42 24.31040	21 04 35.74325	RTK FIX	72.787	Levelling	982302.2719
Ödeshög NA	6453251.337	479682.830	58 13 11.84948	14 39 14.95133	RTK FL	147.994	Levelling	981718.3848
Ödeshög NB	6452603.668	479360.424	58 12 50.85404	14 38 55.40136	RTK FIX	145.157	RTK FIX	981718.4279
Öjaby AA	6307074.029	484177.529	56 54 25.53316	14 44 24.66760	RTK HP	167.946	HP	981615.2703
Ör	6318614.758	481153.438	57 00 38.35673	14 41 22.80613	RTK FIX	172.366	Levelling	981619.2691
Örebro	6567578.998	509325.079	59 14 49.56951	15 09 48.53834	RTK FIX	46.251	Levelling	981816.7046
Örebro 1p	6570543.430	512291.803	59 16 25.13343	15 12 56.38263	RTK FIX	27.112	RTK FIX	981819.9859

Öregrund AA	6692795.241	687845.164	60 19 41.0	18 24 09.0	ABS GNSS	6.460	Levelling	981910.2203
Örnsköldsvik 1p	7023707.417	686068.087	63 17 37.54146	18 42 44.29877	RTK FIX	47.907	RTK FIX	982117.6226
Örnsköldsvik AA	7023707.353	686068.087	63 17 37.53940	18 42 44.29854	RTK FIX	47.889	RTK FIX	982117.5712
Östersund AA	7034926.969	492921.337	63 26 33.85	14 51 29.15	EST	455.964	Levelling	982045.0473
Östersund AB	7004743.572	481979.721	63 10 17.26677	14 38 31.68811	RTK HP	316.707	HP	982044.0920
Östersund B	7034926.985	492913.716	63 26 33.85	14 51 28.60	EST	454.752	Levelling	982045.3061
Östhammar A	6686428.917	683221.293	60 16 23.17336	18 18 47.25056	DGNSS	9.911	Levelling	981908.1570
Östhammar B	6685696.457	681406.252	60 16 02.46606	18 16 46.95526	RTK FIX	15.813	Levelling	981908.1628
Övertorneå AA	7390384.804	881340.924	66 23 51.30364	23 33 24.52136	ABS GNSS	89.517	Levelling	982326.8587
Övertorneå 1p	7390268.397	885888.210	66 23 27.44726	23 39 25.45803	RTK HP	65.514	HP	982329.5543
Överturingen AA	6924419.038	495755.334	62 27 03.36380	14 55 03.86919	RTK FIX	268.646	Levelling	982033.4002

In Table 29 in Appendix 2 there is a summary of the locations where there are more than one existing RG 2000 point and the order in which the points should be used.

In Table 32 in Appendix 2, the difference between RG 2000 and RG 82 is shown for all points originally included in RG 82 which has a g-value in RG 2000 (2019 realization).

10.2.1 Irregularities/anomalies in the result

The point with the highest value in the leave-one-out cross validation is now Särna AA and the value is 26 µGal instead of 24 µGal (see Figure 64). Still, the adjusted value is just a few µGal from that.

The difference in *Haller, Ekman (1988)* between the main and spare points of the RG 82 Zero Order Network used as precomputed differences in the 2018 realization of RG 2000 and the adjusted difference in the 2019 realization when using the real observations is in general much larger than expected. The following changes between the two realizations occur between the two points (NA and NB): Björkliden 0.3 µGal, Jukkasjärvi 3.1 µGal, Jävre 0.4 µGal (but here we had more observations than the recently found ones), Kåbdalis 6.1 µGal, Södertälje 4.8 µGal, Göteborg AA 7.7 µGal, Visby 6.8 µGal, Västervik 1.5 µGal and Ödeshög 0.1 µGal.

10.2.2 Destroyed points and less good points

There are five exceptions to what is written in Subsection 10.1.2:

- The point Lycksele C has been re-observed in 2019 and after that, the old observations were found in a protocol book in the new Geodetic archive. This means that all points in *Haller, Ekman (1988)* have a g-value in RG 2000, except Karlstad NB.
- Descriptions of where the points Hemse 1p and Tingstäde 1p are situated have been found in an old protocol book. It means that these points can be used for further measurements.
- The point Granberget 1p was moved to this main adjustment from the second order adjustment, despite it is a destroyed point. It was observed in 1992 between Åsele and Vilhelmina in one direction in a loop with the two used instruments, which shows quite uneven results. However, the observations fitted better in its context here.
- The observations in Vittangi 1p and Vittangi 2p also fitted better in its context here. There, the benchmark had been moved from the lowest step of the church step to the highest. Vittangi 1p is the place where the benchmark originally was situated at and Vittangi 2p is the place where the benchmark is situated today.
- The point Östersund B was included and some years after the observations there, a mast for GNSS has been mounted on the same small piece of bedrock. The point has not fully been inspected since then, but some photos suggest that it still is a chance that a Scintrex gravimeter can be placed there without touching the mast or have one tripod leg outside of the piece of bedrock. However, if having access to the hut where Östersund AA is situated, this point should not be used anyway.

For more differences between the realizations of RG 2000, see Section 10.3.

10.3 Differences in the results of the two the realizations of RG 2000

The 10 points with the largest difference in their g-values between the two realizations of RG 2000 (in µGal) are the following (2018-2019): Holmsund AA 29.9, Stekenjokk 15.7, Göteborg AA 8.0, Visby NB 7.9, Särna -7.9, Ludvika 1p 7.8, Kåbdalis NB 7.6, Klimpfjäll AA -6.3, Voxna -5.6 and Jukkasjärvi NB 5.3.

For all these 10 points except Särna, more observations have been added in the 2019 realization (see Subsection 7.4.2 and Table 23 in Appendix 2). For Holmsund AA, the A10 observation was removed (see Subsection 7.4.1). For Göteborg AA, Kåbdalis NB and Jukkasjärvi NB, the calculated difference from RG 82 was removed (see Subsection 7.4.3).

All differences can be found in Table 10 and in Figure 66.

Table 10: *The two RG 2000 realizations and the difference between them. *This RG 2000 (2018 realization) value is taken from the second step adjustment.*

Name	RG 2000 (2018 realization)	RG 2000 (2019 realization)	Difference (2018-2019)
Alby	982038.9366	982038.9379	-0.0013
Algutsboda 1p	981620.1237	981620.1251	-0.0014
Ammarnäs	982198.6628	982198.6635	-0.0007
Aneby	981669.6298	981669.6328	-0.0030
Arboga AA	981837.7588	981837.7594	-0.0006
Arbrå	981992.3707	981992.3716	-0.0009
Arjeplog	982237.3308	982237.3331	-0.0023
Arjeplog AA	982253.5764	982253.5779	-0.0015
Arjeplog AB	982237.9054	982237.9081	-0.0027
Arjeplog B	982253.5139	982253.5154	-0.0015
Arvidsjaur	982216.6869	982216.6858	0.0011
Arvidsjaur 1p	982216.0569	982216.0559	0.0010
Arvidsjaur AA	982216.6101	982216.6091	0.0010
Arvika	981844.4364	981844.4384	-0.0020
Augerum AA	981614.9967	981614.9962	0.0005
Avesta	981882.6792	981882.6759	0.0033
Baltak AA	981704.7484	981704.7491	-0.0007
Bergnäset	982298.8392	982298.8386	0.0006
Bjurholm AA	982148.0461	982148.0464	-0.0003
Björkliden NA	982362.0817	982362.0803	0.0014
Björkliden NB	982365.486	982365.4843	0.0017
Björna	982143.3114	982143.3118	-0.0004
Blomstermåla	981658.9368	981658.9396	-0.0028
Boda	982087.9314	982087.9303	0.0011

Boda Bruk AA	981998.3253	981998.3268	-0.0015
Bofors	981804.5710	981804.5696	0.0014
Bollnäs AA	981994.5684	981994.5704	-0.0020
Borgholm	981650.5036	981650.5050	-0.0014
Borgsjö AA	982062.1968	982062.1957	0.0011
Borlänge	981907.8739	981907.8745	-0.0006
Borås	981661.2948	981661.2951	-0.0003
Borås 1p	981685.7600	981685.7595	0.0005
Borås AA	981680.0485	981680.0480	0.0005
Bottnaryd	981671.5860	981671.5896	-0.0036
Bunge	981699.5486	981699.5470	0.0016
Bureå AA	982225.4517	982225.4515	0.0002
Burträsk	982206.1272	982206.1271	0.0001
Dala	981719.7294	981719.7288	0.0006
Dalby	981565.6645	981565.6630	0.0015
Dals Ed	981775.8962	981775.9000	-0.0038
Duved AA	982011.8324	982011.8347	-0.0023
Dörby 1p	981653.0248	981653.0270	-0.0022
Edefors	982340.0009	982340.0001	0.0008
Ekshärad	981828.0002	981828.0033	-0.0031
Eksjö AA	981672.9172	981672.9194	-0.0022
Emmaboda AA	981630.1400	981630.1414	-0.0014
Enköping	981856.0506	981856.0478	0.0028
Eskilstuna	981833.4380	981833.4369	0.0011
Falkenberg AA	981690.6981	981690.6985	-0.0004
Fredrika	982152.2443	982152.2462	-0.0019
Fredriksberg AA	981841.5942	981841.5967	-0.0025
Fryksände AA	981857.4977	981857.5001	-0.0024
Föllinge A	982075.7185	982075.7178	0.0007
Föllinge B	982075.6895	982075.6892	0.0003
Gamleby AA	981728.8080	981728.8081	-0.0001
Garde	981695.0787	981695.0769	0.0018
Gnarp	982030.2488	982030.2486	0.0002

Gothem	981713.3516	981713.3499	0.0017
Gotska Sandön	981746.1880	981746.1876	0.0004
Grinneröd AA	981740.9234	981740.9272	-0.0038
Grythyttan	981819.9034	981819.9012	0.0022
Grytnäs AA	981889.4619	981889.4607	0.0012
Grötlingbo	981654.4254	981654.4228	0.0026
Gulsele	982138.1209	982138.1203	0.0006
Gäddede	982122.7493	982122.7506	-0.0013
Gällivare	982345.2063	982345.2013	0.0050
Gällivare AA	982341.1626	982341.1583	0.0043
Göteborg 1p	981727.0836	981727.0833	0.0003
Göteborg AA	981718.7149	981718.7069	0.0080
Göteborg NB	981718.3359	981718.3356	0.0003
Hakkas	982356.4434	982356.4407	0.0027
Hallstahammar	981838.5542	981838.5543	-0.0001
Hallviken	982108.1886	982108.1892	-0.0006
Hammerdal AA	982093.7993	982093.8005	-0.0012
Haparanda	982321.2034	982321.2006	0.0028
Haparanda AA	982326.9101	982326.9085	0.0016
Hede	981948.3195	981948.3203	-0.0008
Hede AA	981944.6343	981944.6336	0.0007
Helsingborg AA	981608.0574	981608.0568	0.0006
Helsingör Relativ	981580.3596	981580.3578	0.0018
Hemse 1p	981677.2553	981677.2531	0.0022
Hemvavan	982165.8596	982165.8612	-0.0016
Hillerstorp	981643.2400	981643.2387	0.0013
Hofors A	981908.1612	981908.1613	-0.0001
Hofors B	981908.1728	981908.1730	-0.0002
Holmsund AA	982171.1675	982171.1376	0.0299
Hoting	982143.6249	982143.6269	-0.0020
Hundsjön AA	982329.5444	982329.5476	-0.0032
Husby-Ärlinghundra AA	981848.3571	981848.3575	-0.0004

Hybo	982020.3646	982020.3657	-0.0011
Hällnäs	982165.3873	982165.3851	0.0022
Härnösand AA	982070.4251	982070.4243	0.0008
Hörnefors 1p	982149.8927	982149.8925	0.0002
Hörnefors AA	982150.8467	982150.8465	0.0002
Höör A	981580.4167	981580.4164	0.0003
Höör AA	981588.7383	981588.7350	0.0033
Höör B	981580.4167	981580.4149	0.0018
Idre	981885.2943	981885.2978	-0.0035
Johannishus	981612.1317	981612.1312	0.0005
Jokkmokk	982347.3390	982347.3358	0.0032
Jokkmokk 1p	982346.9216	982346.9184	0.0032
Jordbro	981822.8481	981822.8467	0.0014
Jukkasjärvi NA	982361.8563	982361.8541	0.0022
Jukkasjärvi NB	982362.0953	982362.0900	0.0053
Junosuando	982397.6041	982397.6044	-0.0003
Junsele AA	982143.9217	982143.9205	0.0012
Jäkkvik	982242.1798	982242.1821	-0.0023
Jämjö 1p	981611.9180	981611.9175	0.0005
Järpen	982027.9612	982027.9634	-0.0022
Jävre NA	982269.2849	982269.2836	0.0013
Jävre NB	982268.7603	982268.7586	0.0017
Jönköping 1p	981705.8111	981705.8085	0.0026
Kalix	982316.5540	982316.5531	0.0009
Karesuando	982424.9309	982424.9332	-0.0023
Karesuando AA	982428.1776	982428.1794	-0.0018
Karlstad AA	981827.9050	981827.9068	-0.0018
Karlstad NA	981828.1066	981828.1083	-0.0017
Kastlösa	981624.3976	981624.3996	-0.0020
Kiruna AA	982337.1858	982337.1849	0.0009
Kiruna A 1p	982315.3517	982315.3467	0.0050
Kisa	981720.3690	981720.3710	-0.0020
Klimpfjäll AA	982087.8840	982087.8905	-0.0065

Klöveskog AA	981770.5697	981770.5695	0.0002
Korpilombolo	982345.5593	982345.5563	0.0030
Kramfors A	982076.5831	982076.5821	0.0010
Kramfors AA	982075.4097	982075.4084	0.0013
Kramfors AB	982075.7228	982075.7225	0.0003
Kramfors B	982077.0365	982077.0361	0.0004
Kramfors C	982075.5164	982075.5143	0.0021
Kristianstad 1p	981591.2864	981591.2853	0.0011
Krokom	982048.4777	982048.4801	-0.0024
Kvikkjokk NA	982269.0650	982269.0627	0.0023
Kvikkjokk NB	982268.7228	982268.7201	0.0027
Kåbdalis 1p	982271.1742	982271.1726	0.0016
Kåbdalis AA	982270.3863	982270.3848	0.0015
Kåbdalis NB	982268.8994	982268.8918	0.0076
Kärda AA	981625.5730	981625.5729	0.0001
Köpingsvik AA	981650.0972	981650.0970	0.0002
Laforsen	982011.0243	982011.0248	-0.0005
Lagan	981612.4480	981612.4497	-0.0017
Laholm	981652.9949	981652.9954	-0.0005
Lansån	982349.8344	982349.8332	0.0012
Laxå AA	981787.0966	981787.1001	-0.0035
Leksand AA	981907.8041	981907.8046	-0.0005
Lidträsk	982203.0615	982203.0628	-0.0013
Lindesberg	981835.2957	981835.2938	0.0019
Lindesberg 1p	981831.5306	981831.5292	0.0014
Ljungbyholm AA	981653.5563	981653.5586	-0.0023
Ljusdal AA	982021.0263	982021.0283	-0.0020
Ljusfallshammar AA	981785.3021	981785.3030	-0.0009
Ljusnarsberg AA	981836.8009	981836.7972	0.0037
LMV AA	981935.1851	981935.1832	0.0019
Lofsdalen	981893.7451	981893.7447	0.0004
Ludvika	981867.3844	981867.3896	-0.0052

Ludvika 1p	981876.3510	981876.3429	0.0081
Luleå AA	982295.4736	982295.4723	0.0013
Lycksele A	982191.0665	982191.0657	0.0008
Lycksele AA	982196.7412	982196.7412	0.0000
Lönneberga	981680.7662	981680.7687	-0.0025
Lövånger	982223.2002	982223.1986	0.0016
Maglarp AA	981521.7567	981521.7554	0.0013
Malung	981840.6568	981840.6592	-0.0024
Malung 1p	981845.7064	981845.7091	-0.0027
Malå	982217.3575	982217.3571	0.0004
Mariestad AA	981774.0138	981774.0185	-0.0047
Misterhult AA	981682.8734	981682.8746	-0.0012
Mora	981926.1513	981926.1518	-0.0005
Motala	981760.2703	981760.2701	0.0002
Munkfors AA	981826.7485	981826.7445	0.0040
Mårtsbo AA	981923.4366	981923.4355	0.0011
Mårtsbo AB	981923.4425	981923.4414	0.0011
Mårtsbo B	981923.5976	981923.5969	0.0007
Mönsterås 1p	981666.9898	981666.9924	-0.0026
Norra Ny 1p	981843.1606	981843.1631	-0.0025
Norra Råda 1p	981831.7385	981831.7424	-0.0039
Norrköping AA	981789.0427	981789.0414	0.0013
Norrtälje	981857.3897	981857.3908	-0.0011
Norrtälje AA	981860.3561	981860.3581	-0.0020
Norsjö	982190.2052	982190.2033	0.0019
Norsjö AA	982191.1200	982191.1190	0.0010
Nyköping AA	981801.2028	981801.2021	0.0007
Onsala AA	981716.2959	981716.2944	0.0015
Onsala AC	981716.3110	981716.3105	0.0005
Onsala AN	981716.6023	981716.6022	0.0001
Onsala AS	981716.6086	981716.6084	0.0002
Osby	981589.5325	981589.5336	-0.0011
Pajala	982372.8069	982372.8048	0.0021

Pajala 1p	982379.2616	982379.2599	0.0017
Pello 1p	982366.7461	982366.7427	0.0034
Pello NA	982362.3970	982362.3950	0.0020
Pello NB	982365.5155	982365.5136	0.0019
Porjus	982319.7744	982319.7703	0.0041
Ragunda AA	982129.1821	982129.1810	0.0011
Ramsele	982129.9136	982129.9128	0.0008
Ratan AA	982188.9986	982188.9973	0.0013
Ratan B	982188.9356	982188.9327	0.0029
Rimforsa AA	981738.8508	981738.8511	-0.0003
Rätansbyn	982013.4722	982013.4732	-0.0010
Rättvik	981923.1944	981923.1949	-0.0005
Saxnäs	982093.8235	982093.8243	-0.0008
Simrishamn AA	981566.9756	981566.9735	0.0021
Skellefteå AA	982230.3977	982230.3944	0.0033
Skellefteå B	982230.5857	982230.5827	0.0030
Skutskär 1p	981934.5827	981934.5809	0.0018
Skönberga 1p	981780.3192	981780.3171	0.0021
Smögen AA	981770.1929	981770.1911	0.0018
Sollefteå	982115.6388	982115.6375	0.0013
Sollefteå AA	982123.6736	982123.6718	0.0018
Solna	981829.1063	981829.1070	-0.0007
Solna AA	981829.2022	981829.2030	-0.0008
Soppero	982375.7864	982375.7849	0.0015
Soresele	982217.4576	982217.4598	-0.0022
Sorsele AA	982219.0116	982219.0114	0.0002
Stavre	982038.9952	982038.9967	-0.0015
Stavreviken	982082.3278	982082.3273	0.0005
Stekenjokk	982065.2985	982065.2827	0.0158
Stenbrohult 1p	981595.4053	981595.4070	-0.0017
Stensele A	982191.1278	982191.1285	-0.0007
Stensele AA	982174.7399	982174.7410	-0.0011
Stensele B	982191.1955	982191.1962	-0.0007

Stensele B 1p	982174.8864	982174.8873	-0.0009
Stora Tuna 1p	981907.2364	981907.2377	-0.0013
Ström 1p	982108.2611	982108.2604	0.0007
Strömsund	982178.1054	982178.1062	-0.0008
Stugun A	982076.4182	982076.4158	0.0024
Stugun AA	982088.0588	982088.0588	0.0000
Stugun B	982075.6709	982075.6696	0.0013
Stugun C	982075.6121	982075.6080	0.0041
Stugun D	982075.8878	982075.8874	0.0004
Stöllet AA	981819.8760	981819.8786	-0.0026
Sundsvall 1p	982069.8800	982069.8809	-0.0009
Sundsvall AA	982069.8754	982069.8753	0.0001
Sved AA	982086.2404	982086.2416	-0.0012
Sveg	981957.8920	981957.8940	-0.0020
Sveg AA	981967.7259	981967.7293	-0.0034
Svenljunga	981666.0443	981666.0451	-0.0008
Svenstavik AA	982030.8057	982030.8042	0.0015
Svinnegarn AA	981848.0894	981848.0897	-0.0003
Sysslebäck	981864.0453	981864.0487	-0.0034
Säffle AA	981817.0530	981817.0547	-0.0017
Särna	981897.1119	981897.1198	-0.0079
Särna 1p	981905.9317	981905.9362	-0.0045
Särna AA	981906.9946	981906.9995	-0.0049
Sävar AA	982191.0310	982191.0301	0.0009
Sävar B	982191.0048	982191.0052	-0.0004
Sävsjö	981655.0635	981655.0650	-0.0015
Söderhamn 1p	981993.2959	981993.2941	0.0018
Södertälje NA	981828.0854	981828.0847	0.0007
Södertälje NB	981827.9813	981827.9854	-0.0041
Södra Fågelås 1p	981704.6633	981704.6647	-0.0014
Sölvesborg A	981580.4159	981580.4148	0.0011
Sölvesborg AA	981593.8526	981593.8518	0.0008
Sölvesborg B	981580.4210	981580.4199	0.0011

Tandsjöborg	981916.2372	981916.2386	-0.0014
Tanum	981786.1556	981786.1517	0.0039
Tanum AA	981785.7302	981785.7334	-0.0032
Tingstäde 1p	981711.1410	981711.1396	0.0014
Torneträsk	982378.7131	982378.7120	0.0011
Torpshammar	982068.4822	982068.4823	-0.0001
Torsby	981856.1273	981856.1275	-0.0002
Torsås	981641.3434	981641.3444	-0.0010
Torup	981676.6149	981676.6156	-0.0007
Transtrand	981865.6797	981865.6817	-0.0020
Transtrand AA	981867.0802	981867.0820	-0.0018
Tullinge AA	981827.1634	981827.1619	0.0015
Turinge 1p	981826.5804	981826.5811	-0.0007
Tännäs	981907.1965	981907.1981	-0.0016
Tärendö AA	982387.1322	982387.1311	0.0011
Tärnaby	982153.9026	982153.9043	-0.0017
Tärnsjö	981900.8305	981900.8304	0.0001
Uddevalla	981760.2081	981760.2052	0.0029
Ulricehamn AA	981681.2685	981681.2708	-0.0023
Umbukta A	982191.1402	982191.1412	-0.0010
Umbukta AA	982201.9112	982201.9146	-0.0034
Umbukta B	982191.2949	982191.2943	0.0006
Uppsala	981883.6637	981883.6616	0.0021
Uppsala C 1p	981883.8082	981883.8062	0.0020
Urshult	981594.5965	981594.5976	-0.0011
Valla AA	981816.5358	981816.5343	0.0015
Vallvik	981987.8367	981987.8364	0.0003
Vansbro AA	981861.8174	981861.8193	-0.0019
Vara AA	981752.3279	981752.3302	-0.0023
Varberg 1p	981694.8399	981694.8420	-0.0021
Veddige	981696.0552	981696.0552	0.0000
Veinge AA	981656.2492	981656.2500	-0.0008
Vilhelmina	982144.0581	982144.0586	-0.0005

Vilhelmina AA	982131.8166	982131.8182	-0.0016
Vinliden	982151.7089	982151.7108	-0.0019
Virserum AA	981647.0916	981647.0934	-0.0018
Visby AA	981714.3964	981714.3953	0.0011
Visby D	981714.5353	981714.5343	0.0010
Visby NA	981719.2360	981719.2348	0.0012
Visby NB	981718.5477	981718.5397	0.0080
Vittangi	982402.8926	982402.8911	0.0015
Voxna	981967.4398	981967.4455	-0.0057
Voxna AA	981970.0589	981970.0637	-0.0048
Västervik NA	981718.5416	981718.5402	0.0014
Västervik NB	981718.4206	981718.4177	0.0029
Västra Tollstad AA	981725.6222	981725.6194	0.0028
Åmot	981935.3178	981935.3154	0.0024
Ånn	981998.5909	981998.5916	-0.0007
Årjäng AA	981819.3811	981819.3803	0.0008
Åseda	981638.7286	981638.7306	-0.0020
Åsele	982139.8242	982139.8243	-0.0001
Åsele AA	982140.5747	982140.5749	-0.0002
Åstorp	981617.3641	981617.3635	0.0006
Åte	982122.3305	982122.3313	-0.0008
Åtvidaberg	981736.7562	981736.7548	0.0014
Älmhult AA	981588.8841	981588.8860	-0.0019
Älvdalen A	981908.1478	981908.1486	-0.0008
Älvdalen AA	981920.2406	981920.2416	-0.0010
Älvdalen B	981908.1494	981908.1503	-0.0009
Älvsbyn	982299.3086	982299.3062	0.0024
Älvsbyn AA	982302.2744	982302.2719	0.0025
Ödeshög NA	981718.3870	981718.3848	0.0022
Ödeshög NB	981718.4300	981718.4279	0.0021
Öjaby AA	981615.2688	981615.2703	-0.0015
Ör	981619.2679	981619.2691	-0.0012

Örebro	981816.7040	981816.7046	-0.0006
Örebro 1p	981819.9848	981819.9859	-0.0011
Öregrund AA	981910.2202	981910.2203	-0.0001
Örnsköldsvik AA	982117.6210	982117.6226	-0.0016
Östersund AA	982045.0489	982045.0473	0.0016
Östersund AB	982044.0936	982044.0920	0.0016
Östhammar A	981908.1629	981908.1628	0.0001
Östhammar B	981908.1571	981908.1570	0.0001
Övertorneå 1p	982329.5556	982329.5543	0.0013
Övertorneå AA	982326.8599	982326.8587	0.0012
Överturingen AA	982033.3992	982033.4002	-0.0010
Bureå 1p*	982225.4561	982225.4329	0.0232
Granberget 1p*	982119.5396	982119.5372	0.0024
Hamrånge 1p		981965.8941	
LMV Pol 7		981934.5159	
Lycksele C		982191.0793	
Lycksele D		982196.8267	
Nysätra 1p*	982216.4145	982216.4130	0.0015
Onsala A		981716.5199	
Onsala B		981716.3875	
Vittangi 1p*	982405.5139	982405.5138	0.0001
Vittangi 2p*	982405.3811	982405.3799	0.0012
Vassijaure 1p*	982341.5717	982341.5725	-0.0008
Örnsköldsvik 1p*	982117.5920	982117.5712	0.0208
Östersund B*	982045.3154	982045.3061	0.0093

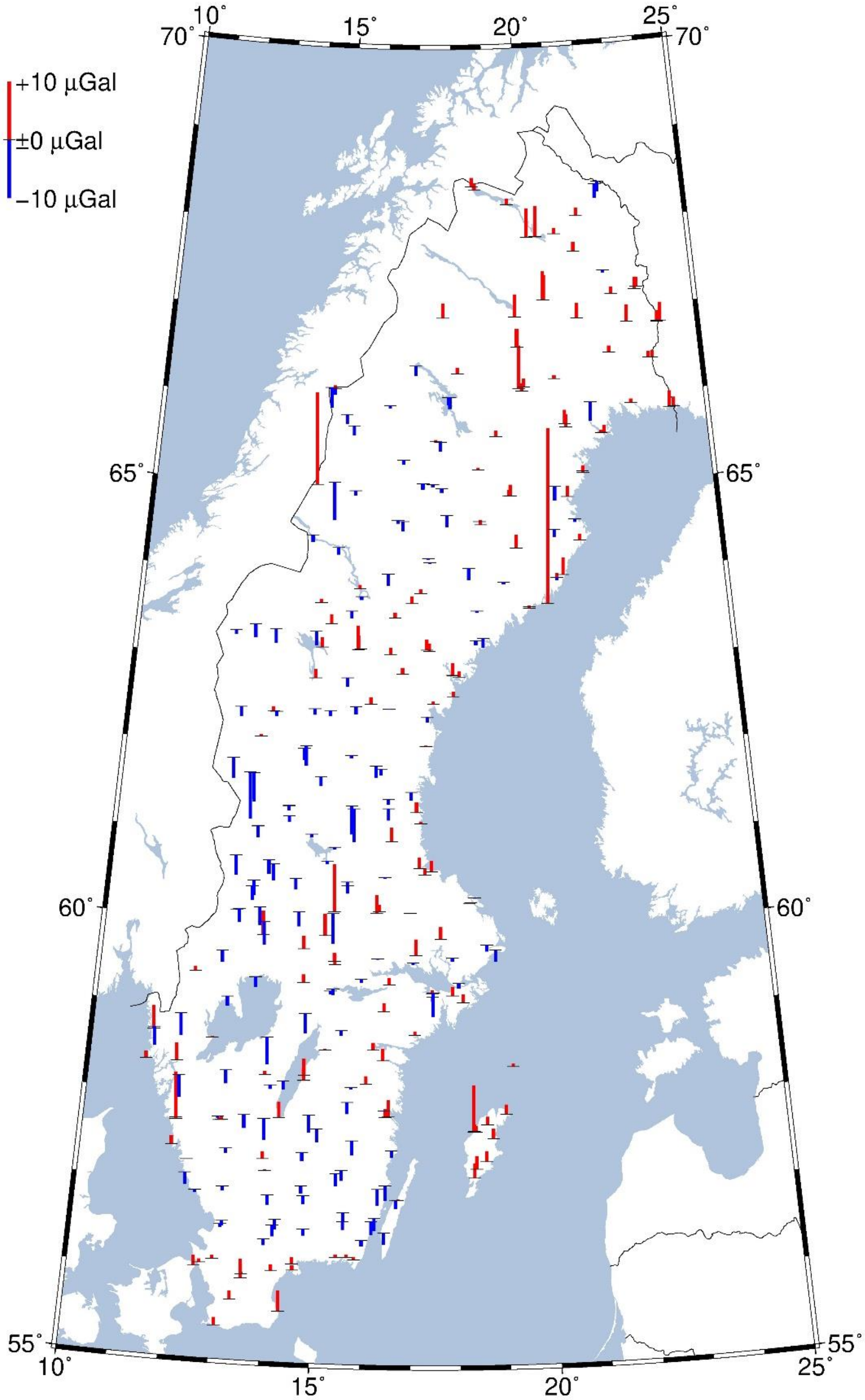

Figure 66: *The difference between the RG 2000 realization from 2018 and the new RG 2000 realization from 2019 (old-new), only for the points included in both the main adjustments.*

The numbers in Figures 57, 58, 59 and 60 from the 2018 realization of RG 2000 and the corresponding Figures 61, 62, 63 and 64 from the 2019 realization, are compared in Tables 11, 12, 13 and 14 below, where the 10 values which stand out the most are shown for the different realizations. It is natural that the numbers are higher in Table 12 for the 2019 realization, since the á priori standard uncertainties were higher for all the absolute observations. By the same reason, it is also natural that the numbers are lower in Table 14 for the 2018 realization.

Table 11: *The largest sigma values (= estimated standard uncertainties). A and B Point name and the sigma value in µGal (2018). C and D Point name and the sigma value in µGal (2019). *The point was not included in the main adjustment in 2018.*

A	B	C	D
Torsby	8.9	Granberget 1p*	11.6
Stekenjokk	8.8	Vassijaure 1p*	9.7
Tanum	8.6	Norra Råda 1p	8.5
Särna	8.6	Östersund B*	7.7
Norra Råda 1p	7.9	Vittangi 1p*	7.6
Gotska Sandön	6.8	Vittangi 2p*	7.6
Örebro 1p	6.7	Gotska Sandön	7.1
Visby NB	6.4	Örebro 1p	7.1
Norra Ny 1p	6.3	Norra Ny 1p	6.7
Umbukta B	6.2	Sorsele	6.3

Table 12: *The largest residuals of the AG points. A and B Point name and the residual in µGal (2018). C and D Point name and the residual in µGal (2019).*

A	B	C	D
Särna AA	-15.6	Särna AA	-20.5
Sveg AA	-13.9	Sveg AA	-17.3
Hundsjön AA	-12.4	Hundsjön AA	-15.7
Norrtälje AA	-10.9	Klimpfjäll AA	-13.6
Hede AA	9.8	Gällivare AA	13.4
Gällivare AA	9.2	Norrtälje AA	-12.9
Kramfors AB	-7.8	Hede AA	10.5
Fredriksberg AA	-7.7	Fredriksberg AA	-10.2
Ljusdal AA	-7.4	Höör AA	9.8
Klimpfjäll AA	-7.1	Tanum AA	-9.7

Table 13: *The largest residuals in the leave-out-one cross validation of the AG points. A and B Point name and the residual in µGal (2018). C and D Point name and the residual in µGal (2019). *Not included in the 2019 realization as an AG point.*

A	B	C	D
Holmsund AA*	28.1	Särna AA	-27.2
Klimpfjäll AA	-28.0	Hundsjön AA	-22.1
Särna AA	-25.7	Sveg AA	-21.6
Hundsjön AA	22.7	Klimpfjäll AA	-19.9
Sveg AA	-20.8	Gällivare AA	17.9
Norrtälje AA	-17.3	Höör AA	17.2
Höör AA	16.4	Norrtälje AA	-16.8
Hede AA	16.3	Tanum AA	-16.2
Tanum AA	-15.7	Fredriksberg AA	-14.9
Gällivare AA	15.3	Hede AA	14.0

Table 14: *The largest residuals in the difference between the leave-out-one cross validation of the AG points and the adjusted value. A and B Point name and the residual in µGal (2018). C and D Point name and the residual in µGal (2019). *Not included in the 2019 realization as an AG point.*

A	B	C	D
Holmsund AA*	-22.7	Ratan AA	-11.7
Klimpfjäll AA	20.9	Visby AA	-8.1
Hundsjön AA	10.3	Arjeplog AA	7.5
Särna AA	10.1	Höör AA	-7.4
Höör AA	-9.9	Älvsbyn AA	6.8
Munkfors AA	-9.6	Särna AA	6.7
Tanum AA	9.2	Grinneröd AA	6.6
Grinneröd AA	9.0	Tanum AA	6.5
Laxå AA	8.7	Hundsjön AA	6.4
Älvsbyn AA	-7.9	Klimpfjäll AA	6.3

10.4 Second step adjustment in 2018

In the second step adjustment the observation series, which were found in the main adjustment to be less good, were included. Also, some observations performed for the FAMOS project (see 7.2.2) are included to give these points a higher status and to calculate the scale factor of the Scintrex CG5-198. This instrument was rarely used in the main adjustment and therefore got the scale factor 1.0 there. Here this factor was determined to 0.999407.

10.4.1 Irregularities/anomalies in the result

Very many of the points are not existing any longer, but they could be used either in order to get an improved transformation connection between RG 62 and RG 2000 or just to give the point itself a better value in RG 2000. The latter is important for the recomputation of geoid measurements based on old data. The quality of the observations is very uneven, so if any of the still existing points should be used, we recommend connecting it to a Class A, B or C point, to ensure the quality.

The exceptions are the FAMOS points, which are marked points close to harbours. These points were observed from two higher class RG 2000 points with Scintrex CG5-198 and Scintrex CG5-740 (and with two exceptions LCR G54 and Scintrex CG5-1184 in Skelleftehamn). They are considered the best of the points from this adjustment and the best Class D points together with the points classed that way from the main adjustment.

10.4.2 Destroyed points and points of insufficient quality

There are 7 points included here which were situated at airports (and 12 such in total in RG 62). None of them have been visited, since we think that they are destroyed and if not, they might be out of reach due to changed security level at airports since 1973. These are Kiruna B 1p, Kallax 1p, Frösön 1p, Arlanda 2 1p, Karlstad B 1p, Bulltofta 1p (this airport is not existing anymore) and Sturup (not included in RG 62). There were also 4 points situated on railway stations included here (and 9 such in total in RG 62). The points which were situated on the platform are all destroyed, which means Bastuträsk 1p, Granberget 1p (included here), Helsingborg Stn 1p, Varberg Stn 1p and Vislanda 1p (included here). The points which were situated on steps to the stations are though still there, which means Morjärv 1p (included here), Moskosel 1p, Slagnäs 1p and Vassijaure 1p (included here). The points Norsjö 1p and Karesuando 1p were both situated on low stones in cemeteries (but no tombstones) and are both destroyed. The point Pustnäs 2 1p is destroyed, but the point Pustnäs 1 1p (which is included in the RG 62 network and was not measured in 1973 where the data here comes from) is still existing. We also suspect that these points are gone: RAK04 1p, Karlsborg 1p (on a bridge foundation), Furudal 1p, Lillebo 1p, Åsarna 1p, Sandsele 1p (on a bridge foundation) and Svappavaara 1p.

One of few marked points in RG 62 was Ljungby 1p. When the reconnoitring was done in 2011, it was discovered that the church step just had been renovated and that the benchmark had moved one step up. The same thing has happened to Vittangi 1p, between the reconnoitring and when it was about to get observed in 2016. Hence, it was observed both where the benchmark once was and where it now is (see Subsection 10.2.2). They are called Vittangi 1p and Vittangi 2p respectively. In this regard, the RG 82 First Order Network point Vittangi some kilometres away is recommended.

10.5 Second step adjustment in 2019

The second step adjustment in 2019 was performed in two different adjustments, since the two kind of points used have nothing more in common than that they have been observed with relative gravimeters. The first adjustment contained the whole RG 62 and was also called “The renovation of RG 62”. The second adjustment contained the FAMOS points and the points included in the main adjustment which were used as starting points.

10.5.1 The renovation of RG 62

This started as a check to see whether the values in RG 62 could be reproduced in Gad via the adjusted observations and their uncertainty values. It was not possible, see Appendix 3, even after getting modern AG values of the three “absolute points” København (from Gabriel Strykowski), Oslo A and Bodø A (from Dagny Lysaker, Kartverket, Hønefoss). After finding more useful relative observations in the new Geodetic Archive (see Subsection 7.2.3), it was instead decided to include them and the observations from 1973 (see Subsection 7.2.1) as normal relative observations with the á priori standard uncertainty 20 µGal and the adjusted RG 62 observations as precomputed differences with the á priori standard uncertainty 40 µGal. The observations in Subsection 7.2.3 which were observed in connection to the RG 82 Zero Order Network campaign got the á priori standard uncertainty 10 µGal.

The points which were included also in the main adjustment of the 2019 realization of RG 2000 got the á priori standard uncertainty 0.1 µGal, exactly as in the second order 2018 adjustment, so that their values would stay the same as there. The three extra absolute points got other á priori standard uncertainties. København B got 2 µGal, Oslo A 5 µGal and Bodø A also 5 µGal. This means that they changed by 0.2 µGal, 4.5 µGal and -1.1 µGal, respectively, in the adjustment. All the values in both RG 2000 and in RG 62 for the all the RG 62 points situated on Swedish ground and for some of the points situated in other countries can be found in Table 15. There is though one exception, the point 01 00 1J (Bromma airport 1) was only observed with a Nørgaard gravimeter and destroyed before RG 62 was finished and was not included here.

Table 15: *Gravity values of the RG 62 points in RG 2000. * means taken from the new realization of RG 2000. ** means point in Denmark, Finland or Norway. *** means new point in 1973.*

Name (RG 2000)	Name (RG 62)	g (RG 2000)	g (RG 62)	Diff (RG2000 - RG 62)
RAK 01 1p	01 00 0A	981831.4036	981846.09	-14.6864
RAK 02 1p	01 00 0B	981831.0694	981845.76	-14.6906

RAK 03 1p	01 00 0C	981827.9308	981842.63	-14.6992
RAK 04 1p	01 00 0D	981827.9278	981842.62	-14.6922
Bromma 2 1p	01 00 1K	981830.8727	981845.56	-14.6873
Tureberg 1p	01 00 2J	981818.515	981833.22	-14.7050
Pustnäs 1 1p	01 00 3J	981886.6114	981901.27	-14.6586
Pustnäs 2 1p	01 00 3K	981886.3757	981901.03	-14.6543
Turinge 1p*	01 02 1J	981826.5811	981841.24	-14.6589
Eskilstuna 1p	01 02 2J	981836.1559	981850.76	-14.6041
Arboga AA*	01 02 3J	981837.7594	981852.31	-14.5506
Vagnhärad 1p	01 04 1J	981815.1438	981829.84	-14.6962
Lunda 1p	01 04 2J	981802.5234	981817.22	-14.6966
Skönberga 1p	01 04 3J	981780.3171	981795.03	-14.7129
Valdemarsvik 1p	01 04 4J	981767.5207	981782.24	-14.7193
Örebro 1p*	02 00 0J	981819.9859	981834.61	-14.6241
Askersund 1p	02 03 1J	981805.7777	981820.46	-14.6823
Karlsborg 1p	02 03 2J	981750.6638	981765.4	-14.7362
S Fågelås 1p*	02 03 3J	981704.6647	981719.46	-14.7953
Karlskoga 1p	02 12 1J	981802.3643	981817.03	-14.6657
Lindesberg 1p*	02 14 1J	981831.5292	981846.15	-14.6208
Ljusnarsberg AA*	02 14 2J	981836.7972	981851.46	-14.6628
S Ludvika 1p	02 14 3J	981860.8141	981875.44	-14.6259
Ludvika 1p*	02 14 4J	981876.3430	981890.96	-14.6170
Stora Tuna 1p*	02 14 5J	981907.2377	981921.84	-14.6023
Leksand 1p	02 14 6J	981907.8408	981922.46	-14.6192
Rättvik 1p	02 14 7J	981924.1941	981938.81	-14.6159
Jönköping 1p*	03 00 0J	981705.8085	981720.61	-14.8015
Nässjö 1p	03 04 1J	981673.6878	981688.42	-14.7322
Eksjö AA*	03 04 2J	981672.9194	981687.62	-14.7006
Vimmerby 1p	03 04 3J	981694.9189	981709.64	-14.7211
Hjälmseryd 1p	03 06 1J	981634.0247	981648.84	-14.8153
Ulricehamn AA*	03 11 1J	981681.2708	981696.02	-14.7492
Borås 1p*	03 11 2J	981685.7595	981700.52	-14.7605
Härryda 1p	03 11 3J	981708.1043	981722.8	-14.6957

Tjust 1p	04 00 0J	981720.2141	981734.95	-14.7359
Ishult 1p	04 05 1J	981684.3878	981699.14	-14.7522
Mönsterås 1p*	04 05 2J	981666.9924	981681.75	-14.7576
Dörby 1p*	05 00 0J	981653.027	981667.79	-14.7630
Algutsboda 1p*	05 06 1J	981620.1251	981634.92	-14.7949
Växjö 1p	05 06 2J	981621.2998	981636.08	-14.7802
Jämjö 1p*	05 07 1J	981611.9175	981626.71	-14.7925
Ronneby 1p	05 07 2J	981614.162	981628.94	-14.7780
Sölvesborg 1p	05 07 3J	981593.8161	981608.59	-14.7739
Vislanda 1p	06 00 0J	981595.5294	981610.34	-14.8106
Stenbrohult 1p*	06 07 1J	981595.407	981610.21	-14.8030
Broby 1p	06 07 2J	981596.5218	981611.31	-14.7882
Ljungby 1p	06 10 1J	981612.0521	981626.89	-14.8379
Nöttja 1p	06 10 2J	981616.8174	981631.61	-14.7926
Kristianstad 1p*	07 00 0J	981591.2854	981606.05	-14.7646
Hörby 1p	07 08 1J	981575.6392	981590.41	-14.7708
Bulltofta 1p	08 00 0J	981543.8445	981558.63	-14.7855
Saxtorp 1p	08 09 1J	981569.5968	981584.37	-14.7732
Helsingborg B 1p	09 00 0J	981609.8307	981624.59	-14.7593
Helsingborg Stn 1p	09 00 0K	981610.0509	981624.81	-14.7591
Helsingborg A 1p	09 00 0L	981609.6556	981624.41	-14.7544
Veinge 1p	10 00 0J	981656.3221	981671.07	-14.7479
Varberg Stn 1p	10 11 1J	981701.9388	981716.67	-14.7312
Varberg B 1p	10 11 1K	981696.3344	981711.07	-14.7356
Varberg 1p	10 11 1L	981694.842	981709.58	-14.7380
Göteborg 1p	11 00 0J	981727.0833	981741.83	-14.7467
Göteborg 2 1p	11 00 0K	981723.5911	981738.34	-14.7489
Göteborg 3 1p	11 00 0L	981726.2727	981741.02	-14.7473
Hogtorp C 1p	11 80 1J	981755.5927	981770.33	-14.7373
Hogtorp B 1p	11 80 1K	981752.9309	981767.67	-14.7391
Hogtorp A 1p	11 80 1L	981752.1834	981766.92	-14.7366
Tanum B 1p	11 80 2J	981786.2127	981800.96	-14.7473
Tanum A 1p	11 80 2K	981785.613	981800.36	-14.7470

Svinesund C 1p	11 80 3J	981825.555	981840.31	-14.7550
Svinesund B 1p	11 80 3K	981837.3021	981852.05	-14.7479
Svinesund A 1p**	11 80 3L	981837.6774	981852.43	-14.7526
Klevberget**	11 80 4J	981888.1479	981902.9	-14.7521
Karlstad A 1p	12 00 0J	981828.2647	981842.96	-14.6953
Karlstad B 1p	12 00 0K	981829.5157	981844.21	-14.6943
Karlstad C 1p		981828.5983		
Deje 1p	12 13 1J	981835.4485	981850.13	-14.6815
Norra Råda 1p*	12 13 2J	981831.7424	981846.4	-14.6576
Norra Ny 1p*	12 13 3J	981843.1631	981857.82	-14.6569
Malung 1p*	12 13 4J	981845.7091	981860.34	-14.6309
Transtrand 1p	12 13 5J	981867.0894	981881.74	-14.6506
Fulunäset 1p	12 13 6J	981886.4115	981901.09	-14.6785
Silbodal A 1p	12 80 1J	981820.0918	981834.84	-14.7482
Silbodal B 1p	-	981820.0603		
Hån 1p	12 80 2J	981834.6757	981849.42	-14.7443
Fossum**	12 80 3J	981878.6445	981893.4	-14.7555
Särna 1p*	13 00 0J	981905.9362	981920.64	-14.7038
Hållstugan 1p	13 14 1J	981885.6209	981900.32	-14.6991
Älvdalen AA*	13 14 2J	981920.2416	981934.92	-14.6784
Orsa 1p	13 14 3J	981935.2412	981949.88	-14.6388
Sörvattnet 1p	13 22 1J	981867.7184	981882.43	-14.7116
Tännäs 1p	13 22 2J	981893.323	981908.03	-14.7070
Hede 1p	13 22 3J	981944.5399	981959.2	-14.6601
Klövsjö 1p	13 22 4J	981956.1043	981970.74	-14.6357
Åsarna 1p	13 22 5J	982022.9831	982037.59	-14.6069
Brunflo 1p	13 22 6J	982035.8347	982050.45	-14.6153
Idre 1p	13 81 1J	981906.1189	981920.84	-14.7211
Lillebo 1p	13 81 2J	981847.7833	981862.54	-14.7567
Furudal 1p	14 00 0J	981929.4861	981944.11	-14.6239
Voxna 1p	14 15 1J	981968.6828	981983.29	-14.6072
Edsbyn 1p	14 15 2J	981967.0612	981981.66	-14.5988
Bollnäs Åsen 1p	15 00 0J	981987.6856	982002.26	-14.5744

Bollnäs AA*	15 00 0K	981994.5704	982009.14	-14.5696
Skutskär 1p*	16 00 0J	981934.5809	981949.2	-14.6191
Hamrånge 1p*	16 19 1J	981965.894	981980.55	-14.6560
Uppsala A 1p	17 00 0A	981884.3787	981899.02	-14.6413
Uppsala B 1p	17 00 0B	981884.4087	981899.05	-14.6413
Uppsala C 1p*	17 00 0C	981883.8062	981898.45	-14.6438
Arlanda 1 1p	18 00 0J	981850.4569	981865.14	-14.6831
Arlanda 2 1p	18 00 0K	981851.6247	981866.31	-14.6853
Söderhamn 1p*	19 00 0J	981993.2941	982007.91	-14.6159
Hudiksvall 1p	19 20 1J	982020.8211	982035.47	-14.6489
Harmånger 1p	19 20 2J	982034.2563	982048.87	-14.6137
Sundsvall N 1p	19 20 3J	982045.9142	982060.57	-14.6558
Sundsvall 1p*	19 20 3K	982069.8809	982084.52	-14.6391
Midlanda A 1p	19 20 4J	982087.2724	982101.89	-14.6176
Midlanda B 1p	19 20 4K	982086.6134	982101.23	-14.6166
Gudmundrå 1p	20 00 0J	982105.5478	982120.15	-14.6022
Vibyggerå 1p	20 28 1J	982116.2268	982130.87	-14.6432
Sollefteå AA*	21 00 0J	982123.6718	982138.34	-14.6682
Graninge 1p	21 22 1J	982092.5383	982107.2	-14.6617
Ragunda AA*	21 22 2J	982129.181	982143.82	-14.6390
Stugun AA*	21 22 3J	982088.0588	982102.7	-14.6412
Östersund AB*	22 00 0J	982044.092	982058.74	-14.6480
Frösön 1p	22 00 0K	982026.8217	982041.5	-14.6783
Hammerdal AA*	22 23 1J	982093.8005	982108.45	-14.6495
Ström 1p*	22 23 2J	982108.2604	982122.92	-14.6596
Hoting 1p	22 23 3J	982135.7656	982150.43	-14.6644
Granberget 1p*	22 23 4J	982119.5372	982134.22	-14.6828
Vilhemina AA*	22 23 5J	982131.8182	982146.46	-14.6418
Alsen 1p	22 82 1J	982031.2051	982045.86	-14.6549
Duved AA*	22 82 2J	982011.8347	982026.52	-14.6853
Storlien 1p	22 82 3J	981977.1794	981991.9	-14.7206
Stensele A 1p	23 00 0J	982174.9266	982189.57	-14.6434
Stensele B 1p**.*	-	982174.8873		

Strömsund 1p	23 83 1J	982175.9091	982190.56	-14.6509
Forsmark 1p	23 83 2J	982167.7143	982182.39	-14.6757
Tärnaby A 1p	23 83 3J	982155.099	982169.8	-14.7010
Tärnaby K 1p	23 83 3K	982154.0289	982168.73	-14.7011
Umfors 1p	23 83 4J	982169.3658	982184.08	-14.7142
Umbukta AA*	23 83 5J	982201.9146	982216.64	-14.7254
Sandsele 1p	24 00 0J	982208.1954	982222.84	-14.6446
Malå 1p	24 25 1A	982221.8077	982236.37	-14.5623
Norsjö 1p	24 25 2J	982191.6088	982206.12	-14.5112
Norsjö T 1p***	-	982191.1624		
Slagnäs 1p	24 32 1J	982211.9254	982226.57	-14.6446
Arvidsjaur 1p*	24 32 2J	982216.0559	982230.68	-14.6241
Moskosel 1p	24 32 3J	982244.6083	982259.24	-14.6317
Kåbdalis 1p*	24 32 4J	982271.1726	982285.81	-14.6374
Tårrajaur 1p	24 32 5J	982306.1666	982320.81	-14.6434
Jokkmokk 1p*	24 32 6J	982346.9184	982361.56	-14.6416
Jokkmokk 2 1p	24 32 6K	982347.2084	982361.85	-14.6416
Porjus 1p	24 32 7J	982317.1881	982331.84	-14.6519
Bastuträsk 1p	25 00 0J	982193.1094	982207.74	-14.6306
Finnfors 1 1p	25 30 1J	982196.0662	982210.75	-14.6838
Finnfors 2 1p	25 30 1K	982195.7962	982210.48	-14.6838
Nysätra 1p*	26 00 0J	982216.4130	982231.06	-14.6470
Umeå 1p	27 00 0J	982188.2216	982202.90	-14.6784
Olovsfors 1p	27 28 1J	982152.2193	982166.89	-14.6707
Örnsköldsvik 1p*	28 00 0J	982117.5712	982132.26	-14.6888
Grundsunda 1p	28 29 1J	982129.6344	982144.31	-14.6756
Hörnefors 1p*	29 00 0J	982149.8925	982164.57	-14.6775
Bureå N 1p	30 00 0J	982221.0697	982235.80	-14.7303
Bureå 1p*	30 00 0K	982225.4329	982240.16	-14.7271
Byske 1p	30 31 1J	982242.6008	982257.32	-14.7192
Piteå 1p	30 31 2J	982286.6141	982301.31	-14.6959
Kallax 1p	30 31 3J	982298.5569	982313.24	-14.6831
Luleå AA*	30 31 4J	982295.4723	982310.16	-14.6877

Morjärv 1p	31 00 0J	982319.4011	982333.94	-14.5389
Lansjärv 1p	31 32 1J	982363.235	982377.81	-14.5750
Haparanda 1 1p	31 92 1J	982324.8707	982339.42	-14.5493
Gällivare AA*	32 00 0J	982341.1583	982355.8	-14.6417
Moskojärvi 1p	32 33 1J	982345.9118	982360.56	-14.6482
Svappavaara 1p	33 00 0J	982370.7546	982385.43	-14.6754
Vittangi 1p	33 35 1J	982405.5137	982420.19	-14.6763
Soppero 1p	33 35 2J	982377.5431	982392.2	-14.6569
Karesuando 1p	33 35 3J	982428.1191	982442.74	-14.6209
Karesuando AA***. *	-	982428.1794		
Kiruna A 1p	34 00 0J	982315.3467	982330.11	-14.7633
Kiruna B 1p	34 00 0K	982340.0341	982354.75	-14.7159
Vassijaure 1p*	34 86 1J	982341.5725	982356.36	-14.7875
Björnfjell**	34 86 2J	982340.9539	982355.68	-14.7261
Muodoslombolo 2 1p	35 00 0J	982432.8491	982447.46	-14.6109
Muodoslombolo 1p	35 00 0K	982427.5053	982442.12	-14.6147
Kihlanki 1p	35 36 1J	982395.5533	982410.17	-14.6167
Pajala 1p*	35 36 2J	982379.2599	982393.87	-14.6101
Pello 1p*	36 00 0J	982366.7427	982381.31	-14.5673
Övertorneå 1p*	36 37 1J	982329.5543	982344.05	-14.4957
Karungi 1p	37 00 0J	982328.9710	982343.49	-14.5190
Haparanda 2 1p	37 92 1J	982325.5227	982340.02	-14.4973
København B**	70 00 0B	981543.1936	981557.91	-14.7164
Oslo A**	80 00 0A	981912.5433	981927.29	-14.7467
Oslo B**	80 00 0B	981914.0759	981928.81	-14.7341
Vinstra A**	81 00 0K	981904.6443	981919.43	-14.7857
Stjördal**	82 00 0M	982141.6462	982156.37	-14.7238
Mo i Rana J**	83 00 0J	982309.5867	982324.27	-14.6833
Mo i Rana K**	83 00 0K	982308.7931	982323.46	-14.6669
Mo i Rana L**	83 00 0L	982307.6598	982322.36	-14.7002
Bodö A**	84 00 0A	982372.2625	982387.29	-15.0275
Bodö B**	84 00 0B	982371.4765	982386.5	-15.0235
Fauske**	85 00 0J	982322.9036	982337.64	-14.7364

Narvik J**	86 00 0J	982437.0629	982451.85	-14.7871
Narvik K**	86 00 0K	982436.8311	982451.61	-14.7789
Narvik M**	86 00 0M	982438.4148	982452.97	-14.5552
Koivulahti**	91 00 0J	982099.5622	982114.3	-14.7378
Kemi**	92 00 0J	982308.0946	982322.61	-14.5154

The difference between RG 2000 and RG 62 can not only be found in Table 15, it is also shown in Table 20 in Subsection 12.2.6. The largest difference on a Swedish point between RG 2000 and RG 62 is -14.8379 mGal in Ljungby 1p and the smallest difference on a Swedish point between the systems is -14.4957 mGal in Övertorneå 1p.

The derived scale factor of the Worden Master 544 gravimeter was 1.000700 with an uncertainty of 0.000086, the scale factor of the Worden 362 gravimeter 1.000616 with an uncertainty of 0.0000196, the scale factor of LCR G54 1.0000017 with an uncertainty of 0.000028, and the scale factor of LCR G290 0.999963 with an uncertainty of 0.000031. Finally, there was a scale factor derived for the average of the five additional Worden or Worden Master gravimeters observing between Veinge 1p and Oslo A. The derived scale factor for them was 1.000609 with an uncertainty of 0.000146.

The difference between the RG 2000 values in the 2018 second step adjustment for the included RG 62 points and the RG 2000 values in the 2019 realization is generally quite small (see Table 16). The largest difference is Oslo A with 41.7 µGal, followed by Silbodal A 1p 37.0 µGal, Helsingborg B 1p 23.3 µGal, Bureå 1p 23.2 µGal and Örnsköldsvik AA 20.8 µGal. The reason for the first two is that a good value for Oslo A was included in the 2019 realization and Silbodal A 1p is connected to two points in the 2018 realization of which Oslo A is one. The reason for the two last is that Bureå 1p and Örnsköldsvik 1p now has got a good value through the new relative observations to Bureå AA and Örnsköldsvik AA, respectively.

Table 16: *The values of the RG 62 points included in the second step adjustment in 2018 and its g-values in both the realization and its differences.*

Name	RG 2000 (2019 realization)	RG 2000 (2018 realization)	Difference (2019 – 2018)
RAK 04 1p	981827.9278	981827.9308	-0.0030
Tureberg 1p	981818.5150	981818.5068	0.0082
Pustnäs 2 1p	981886.3757	981886.3762	-0.0005
Karlsborg 1p	981750.6638	981750.6644	-0.0006
Leksand 1p	981907.8408	981907.8397	0.0011
Härryda 1p	981708.1043	981708.0907	0.0136

Tjust 1p	981720.2141	981720.2145	-0.0004
Vislanda 1p	981595.5294	981595.5313	-0.0019
Ljungby 1p	981612.0521	981612.0465	0.0056
Bulltofta 1p	981543.8445	981543.8366	0.0079
Helsingborg B 1p	981609.8307	981609.8074	0.0233
Helsingborg A 1p	981609.6556	981609.6541	0.0015
Veinge 1p	981656.3221	981656.3282	-0.0061
Karlstad B1p	981829.5157	981829.5100	0.0057
Silbodal A 1p	981820.0918	981820.0548	0.0370
Åsarna 1p	982022.9831	982022.9862	-0.0031
Lillebo 1p	981847.7833	981847.7772	0.0061
Furudal 1p	981929.4861	981929.4855	0.0006
Edsbyn 1p	981967.0612	981967.0615	-0.0003
Uppsala B 1p	981884.4087	981884.4154	-0.0067
Arlanda 2 1p	981851.6247	981851.6216	0.0031
Gudmundrå 1p	982105.5478	982105.5355	0.0123
Frösön 1p	982026.8217	982026.8155	0.0062
Granberget 1p	982119.5372	982119.5396	-0.0024
Stensele A 1p	982174.9266	982174.9228	0.0038
Stensele B 1p	982174.8873	982174.8864	0.0009
Tärnaby A 1p	982154.0289	982154.0256	0.0033
Sandsele 1p	982208.1954	982208.1957	-0.0003
Norsjö 1p	982191.6088	982191.6163	-0.0075
Nysätra 1p	982216.4130	982216.4145	-0.0015
Umeå 1p	982188.2216	982188.2288	-0.0072
Örnsköldsvik 1p	982117.5712	982117.5920	-0.0208
Bureå 1p	982225.4329	982225.4561	-0.0232
Kallax 1p	982298.5569	982298.5649	-0.0080
Morjärv 1p	982319.4011	982319.4062	-0.0051
Svappavara 1p	982370.7546	982370.7598	-0.0052
Vittangi 1p	982405.5138	982405.5139	-0.0001
Vittangi 2p	982405.3799	982405.3811	-0.0012
Karesuando 1p	982428.1191	982428.1249	-0.0058

Kiruna A 1p	982315.3467	982315.3517	-0.0050
Kiruna B 1p	982340.0341	982340.0395	-0.0054
Vassijaure 1p	982341.5725	982341.5717	0.0008
Muodoslombolo 1p	982427.5053	982427.5046	0.0007
Karungi 1p	982328.9710	982328.9705	0.0005
Haparanda 1p	982325.5227	982325.5263	-0.0036
Oslo A	981912.5433	981912.5016	0.0417
Mo i Rana K	982308.7931	982308.7929	0.0002
Narvik K	982436.8311	982436.8305	0.0006

10.5.2 The adjustment of the FAMOS points

The derived scale factor of CG5-198 became 0.999419 which is close to the one derived in the 2018 adjustment. Apart from that, the g-value of the new points changed in a normal way and there were no anomalies in the result. The g-values in RG 2000 can be seen in Table 17.

Table 17: *The RG 2000 values of the FAMOS points and the additional points (from RG 62 renovation) included in the second step adjustment in 2019 and the difference between the new (2019) and the old (2018) realization.*

Name	g-value in RG 2000 (2019)	Difference RG 2000 (2019-2018 solutions)
Ystad, The Theatre	981530.1644	-0.0030
Ystad, St Maria church	981529.1699	-0.0033
Åhus, St Maria church	981580.3875	-0.0009
Åhus, Benchmark 34-0009	981580.5879	-0.0010
Karlshamn, Carl Gustaf church	981610.9354	-0.0008
Karlshamn, Benchmark 34-5708	981604.6719	-0.0008
Ronneby, Benchmark 7355390	981614.1379	-0.0005
Ronneby, Benchmark 35-6413	981613.4149	-0.0005
Karlskrona, The Fredrik church	981612.3118	-0.0005
Karlskrona, Benchmark 35-3818	981612.6846	-0.0005
Kalmar, Tullhuset	981648.4406	0.0024
Kalmar, Cathedral	981647.8075	0.0024
Oxelösund, Benchmark 97-1502	981802.4456	-0.0009

Oxelösund, Benchmark 97-1504	981804.7367	-0.0009
Stockholm, Benchmark 108-6527	981833.5118	0.0007
Stockholm, Benchmark SS301025	981833.0693	0.0008
Ljusne, Benchmark 147-7415	981990.2840	-0.0002
Ljusne, Tele	981992.0738	-0.0002
Skelleftehamn, Benchmark 2217190	982221.4316	-0.0015
Skelleftehamn, St Örjan church	982225.7010	-0.0012
Sturup airport (Pettersson)	981530.1476	0.063
Tösse church (Pettersson)	981804.9297	0.0123
Norrby church (Pettersson)	981869.7094	0.010
Kårböle church (Pettersson)	982022.2224	-0.0008
Norsjö church step (Petterssson)	982191.1624	-0.0030

11 Classification of points

In total, 399 points were included in the two steps in the adjustment of the first realization of RG 2000 in 2018 (see Chapter 9 and 10). Of these, 368 are classified according to the four classes in Table 18. The 31 not classified points are either destroyed or situated in Denmark or Norway.

In total, 491 points were included in the two steps in the adjustment of the second realization of RG 2000 in 2019 (see Chapter 9 and 10). All of these are classified according to the four classes in Table 18, no matter if they are destroyed or situated in Denmark, Finland or Norway.

Table 18: *The classification of RG 2000 points.*

	Number of points	Description
Class A in 2018	17	Observed with the FG5
Class A in 2019	18	Observed with the FG5
Class B in 2018	96	Observed with the A10
Class B in 2019	95	Observed with the A10
Class C in 2018	181	Observed with relative gravimeters, considered as very good in the main RG 2000 adjustment
Class C in 2019	230	Observed with relative gravimeters in the main RG 2000 adjustment
Class D in 2018	74	Observed with relative gravimeters, considered less suitable in the main RG 2000 adjustment or included in the second adjustment
Class C in 2019	148	Observed only in the second adjustment

In the following Sections and Subsections, the classifications in 2018 and 2019 are presented class by class.

11.1 Class A

A Class A point is a point where FG5 has observed. These are the same points for both the main adjustment from 2018 and the main adjustment from 2019, with one exception.

When RG 2000 first was calculated and adjusted, there were 17 Class A points in 13 different locations. The only Class B point (Holmsund AA) where it would be possible to observe for a FG5 has been observed with FG5X-233 in June 2019. In none of the realizations of RG 2000 it has been used as a Class A point, but in future realizations it will be – in case it will be observed more times. It fulfils the requirements for a Class A point, thus it has now been upgraded.

For access to most of the Class A points, a key is needed. It means that they are not available for anyone without contacting Lantmäteriet, Onsala Space Observatory (the four points in Onsala) or RISE (the point Borås AA). Though, there are other options to use these locations via reserve points, see Table 19.

Table 19: *Reserve points (all Class C, except * Class B) for the Class A points, easily accessible.*

Class A point	Reserve point	Location	Marked
Arjeplog AA	Arjeplog B	< 20 m	Benchmark
Borås AA	Borås	About 10 km	Benchmark
Holmsund AA	None	> 40 km	
Kiruna AA	Jukkasjärvi NA	About 20 km	Benchmark
Kramfors AA	Kramfors AB*	< 1 km	Benchmark
LMV AA	LMV Pol 7	About 200 m	Pipe
Lycksele AA	Lycksele A	About 5 km	Benchmark
Mårtsbo AA	Mårtsbo B	< 200 m	Benchmark
Onsala all	Onsala A	< 200 m	Benchmark
Onsala all	Onsala B	About 1,5 km	Benchmark
Ratan AA	Ratan B	< 10 m	Benchmark
Skellefteå AA	Skellefteå B	< 10 m	Benchmark
Smögen AA	None	>40 km	
Visby AA	Visby D	< 10 m	Benchmark
Östersund AA	Östersund B or Föllinge A	< 10 m / About 30 km	Benchmark

All the Class A points from the 2019 realization of RG 2000 is shown in Figure 67.

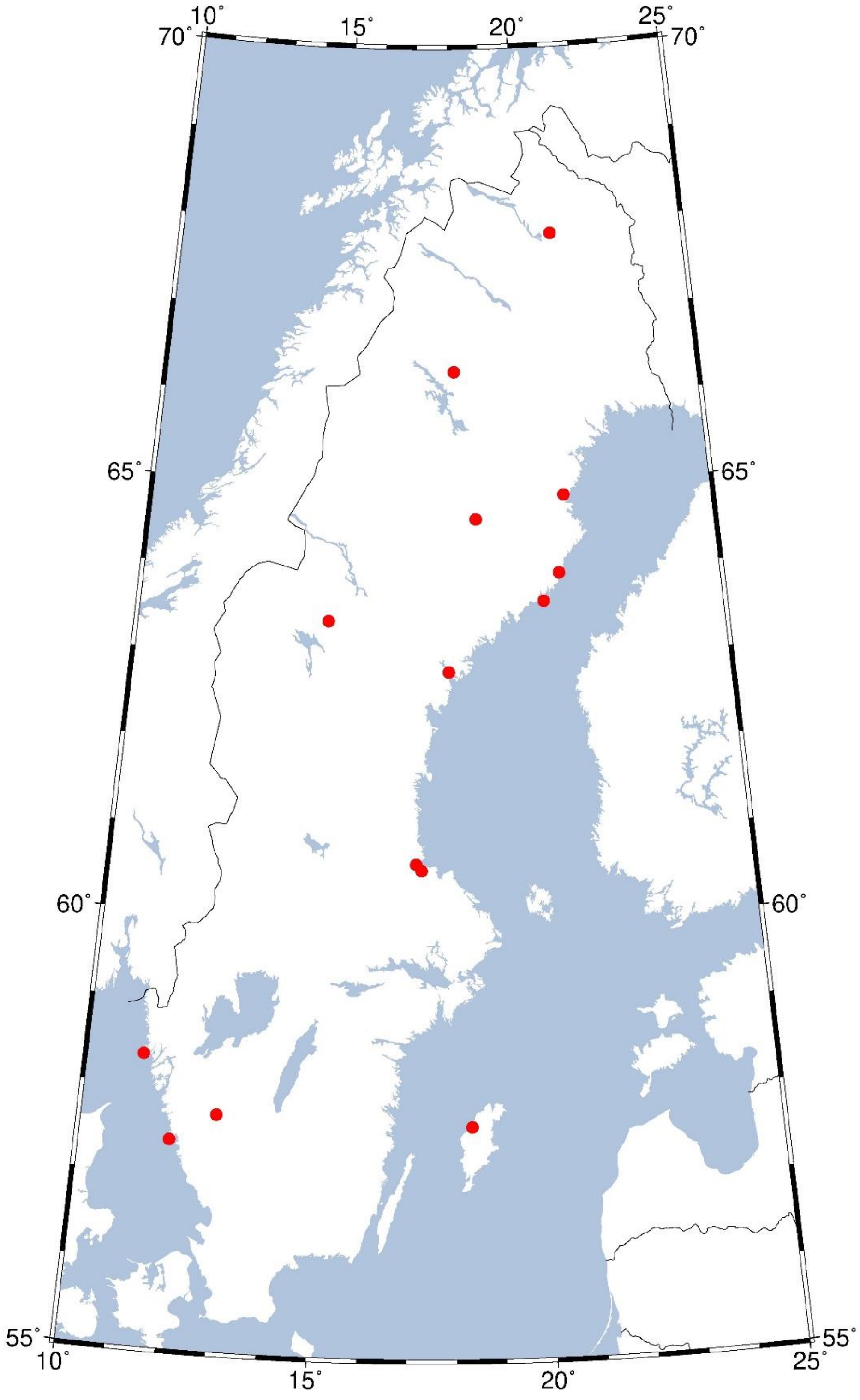

Figure 67: *All Class A points in 2019.*

11.2 Class B

A Class B point is a point where an A10 has observed, but no FG5 has observed. These are the same points for both the main adjustment from 2018 and the main adjustment from 2019, with one exception.

There was originally 97 Class B points, but the observation at point Voxna AA was an outlier and therefore the point was degraded to a Class C point. The point Holmsund AA was in the main adjustment in 2019 upgraded to a Class A point (see 11.1). All the Class B points from the 2019 realization of RG 2000 is shown in Figure 69.

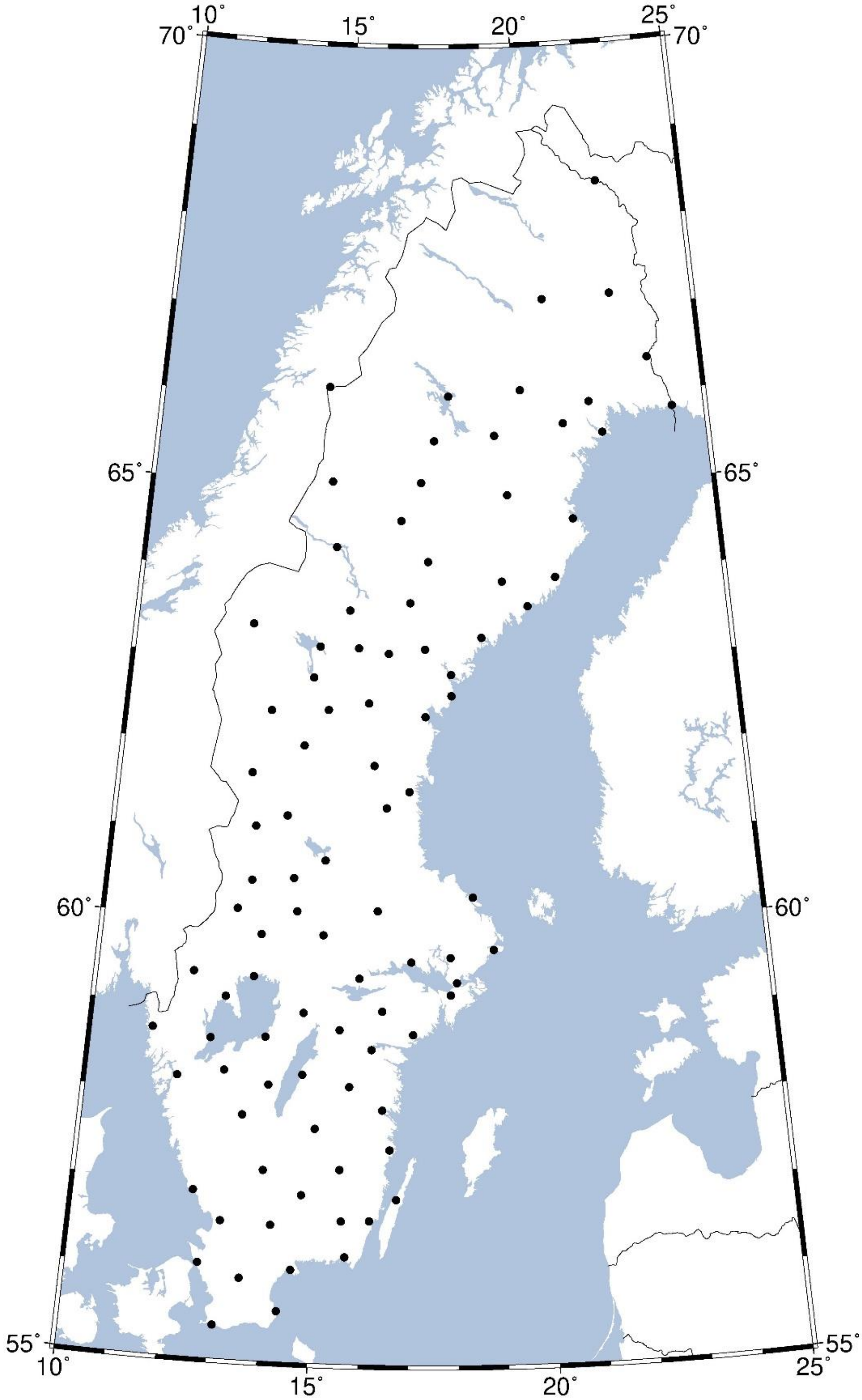

Figure 68: *All Class B points in 2019.*

11.3 Class C

A Class C point is a point only observed with relative gravimeters. The definition of a Class C point differed in the main adjustment in 2018 and the main adjustment in 2019.

11.3.1 Class C points in the adjustment 2018

A Class C point was a point only observed with relative gravimeters which was considered as very good in the main RG 2000 adjustment. The five destroyed points Alby, Gothem, Hofors A, Mora and Rättvik and the Danish point Helsingør R, which all fulfil the criteria of Class C are not counted here.

11.3.2 Class C points in the adjustment 2019

For simplification, it was in 2019 decided that a Class C point should be a point included in the main adjustment, no matter the quality of the point, no matter in which country it is situated or no matter if it is still existing or destroyed. After the adjustment in 2018, two of the former Class D points (Ludvika and Stekenjokk) - chosen to be Class D points due to their large uncertainty- have been observed relatively again and therefore would have been upgraded to Class C points even without the new directives. 14 new points have also been included in the main adjustment. All the Class C points from the 2019 realization of RG 2000 is shown in Figure 69.

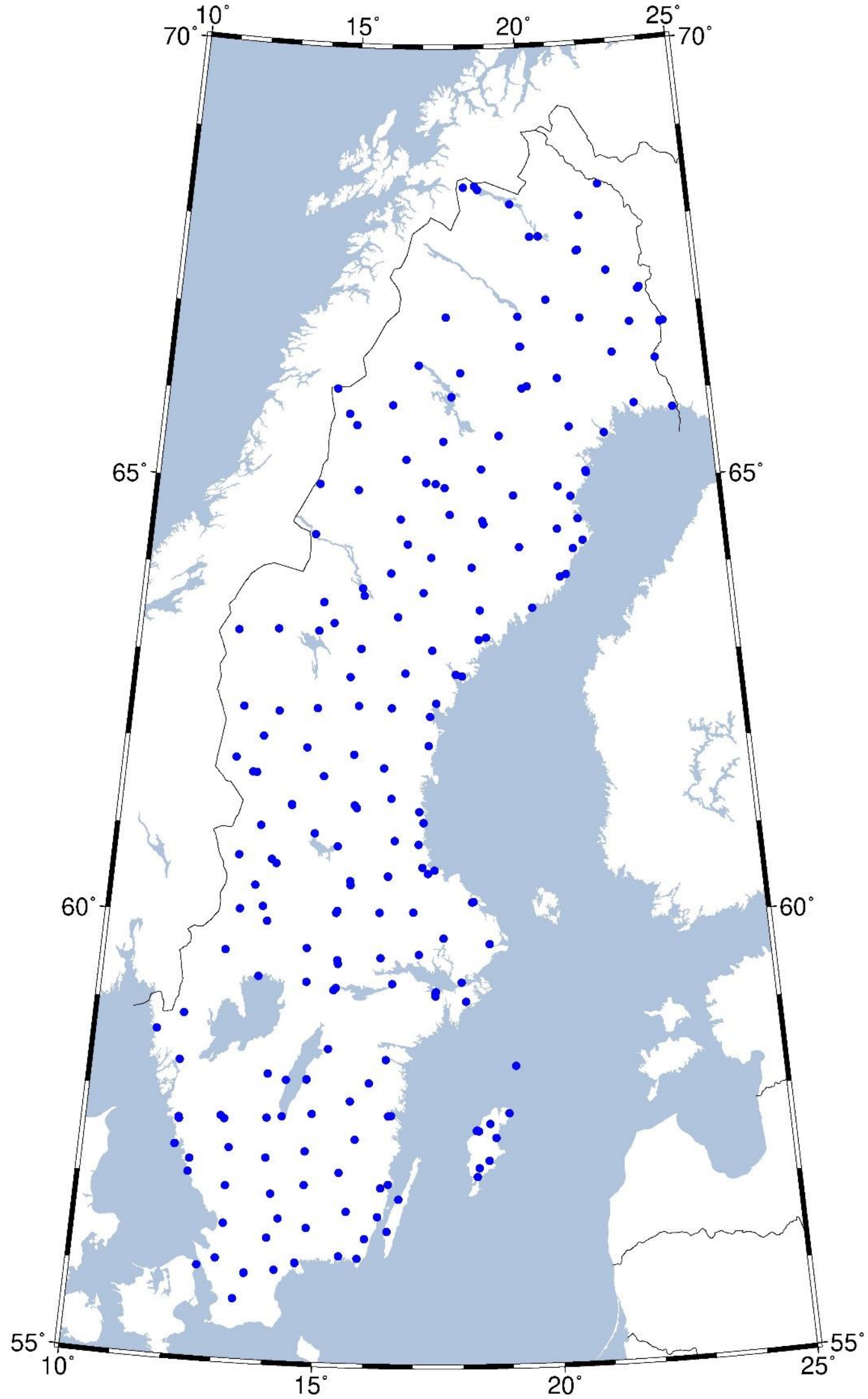

Figure 69: *All Class C points in 2019.*

11.4 Class D

The definition of a Class D point differed in the main adjustment 2018 and the main adjustment 2019.

11.4.1 Class D points in the adjustment 2018

A Class D point was a point only observed with relative gravimeters, considered less suitable in the main RG 2000 adjustment or included in the second adjustment. There were 25 of the earlier and 49 of the latter. Among the latter, 20 points are harbour points for FAMOS. The destroyed point Torsby from the main adjustment, all the destroyed points from the second step adjustment, the five points with at the time unknown location Hemse 1p, Tingstäde 1p, Norrby, Tösse and Kårböle and the three Norwegian points Oslo A, Mo i Rana K and Narvik K all fulfil the criteria of a Class D point, but they are not counted.

11.4.2 Class D points in the adjustment 2019

For simplification, it was in 2019 decided that a Class D point should be a point only included in the second adjustment, no matter how it was observed, no matter the quality of the point, no matter in which country it is situated or no matter if it is still existing or is destroyed. The latter due to the facts that it is hard to know when a point is destroyed without reconnoitring them every year. Many RG 62 points are included which never were reconnoitred since they were found unsuitable for RG 2000 (situated on bridges etc). Here, also the number of Class D points has been doubled since the whole RG 62 network was included. All the Class D points from the 2019 realization of RG 2000 is shown in Figure 70.

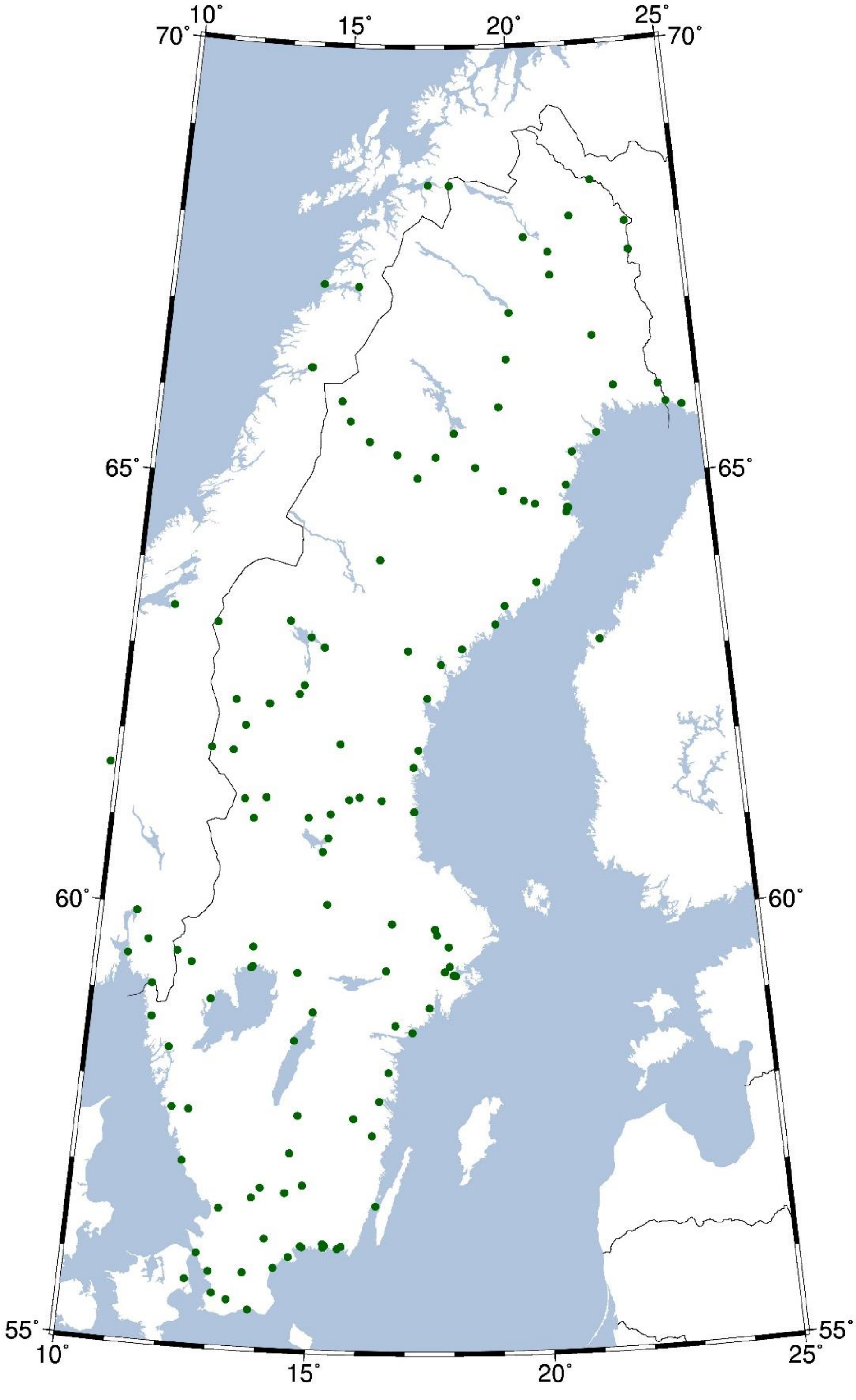

Figure 70: *All Class D points in 2019.*

12 Transformation

Transformations have been derived between RG 2000 and the two previous reference frames, RG 82 and RG 62. In the following Sections and Subsections, the developed transformations are described and discussed.

12.1 Transformation RG 82 to RG 2000

The chosen transformation between RG 82 and RG 2000 is an inclined plane. First was a 1-parameter fit transformation derived. Both these transformations are presented in the following Subsections.

12.1.1 1-parameter fit

As a first test, a 1-parameter fit was derived between RG 82 and RG 2000, after correction for land uplift. The 1-parameter fit is based on 24 of the points included in the Zero Order Network of RG 82 (see Figure 71). The resolved transformation parameter is 28.2 µGal, and standard uncertainty in one common point is 6.1 µGal. The 25th RG 82 Zero Order Network point Björkliden NA is regarded as outlier and thus not included.

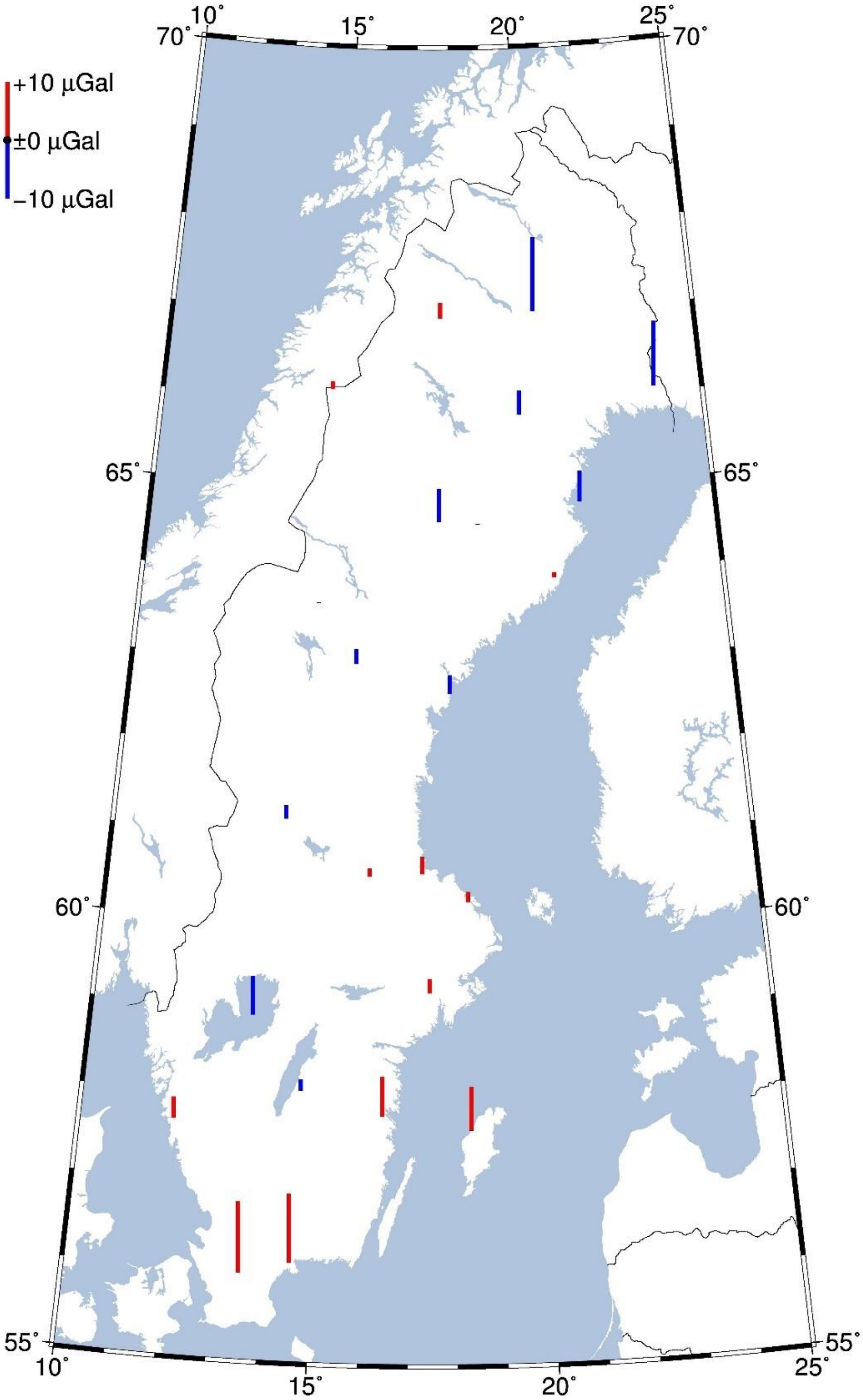

Figure 71: *Residuals in 1-parameter fit between RG 2000 and RG 82 after correction for land uplift.*

12.1.2 Inclined plane

As a second test, in the Lantmäteriet software Gtrans an inclined plane was derived between RG 82 and RG 2000, after correction for land uplift. The inclined plane is based on 24 of the points included in the Zero Order Network of RG 82 (see

Figure 72). The standard uncertainty in one common point is 4.5 µGal. The 25th RG 82 Zero Order Network point Björkliden NA is regarded as outlier and not included.

The formula is:

$$Gt \;=\; Gf + Co + Cx*xf + Cy*yf - vH, \qquad (6)$$

where

Co= .04297219890 = 2.59 * S(Co)

Cx= -.00110840180 = 3.44 * S(Cx)

Cy= -.00013916077 = .34 * S(Cy)

S(Co) = .016584

S(Cx) = 322.289898 PPM

S(Cy) = 408.639131 PPM

Max ABS(vH) = 0.0101 for point Karlstad NA.

The unit here is mGal.

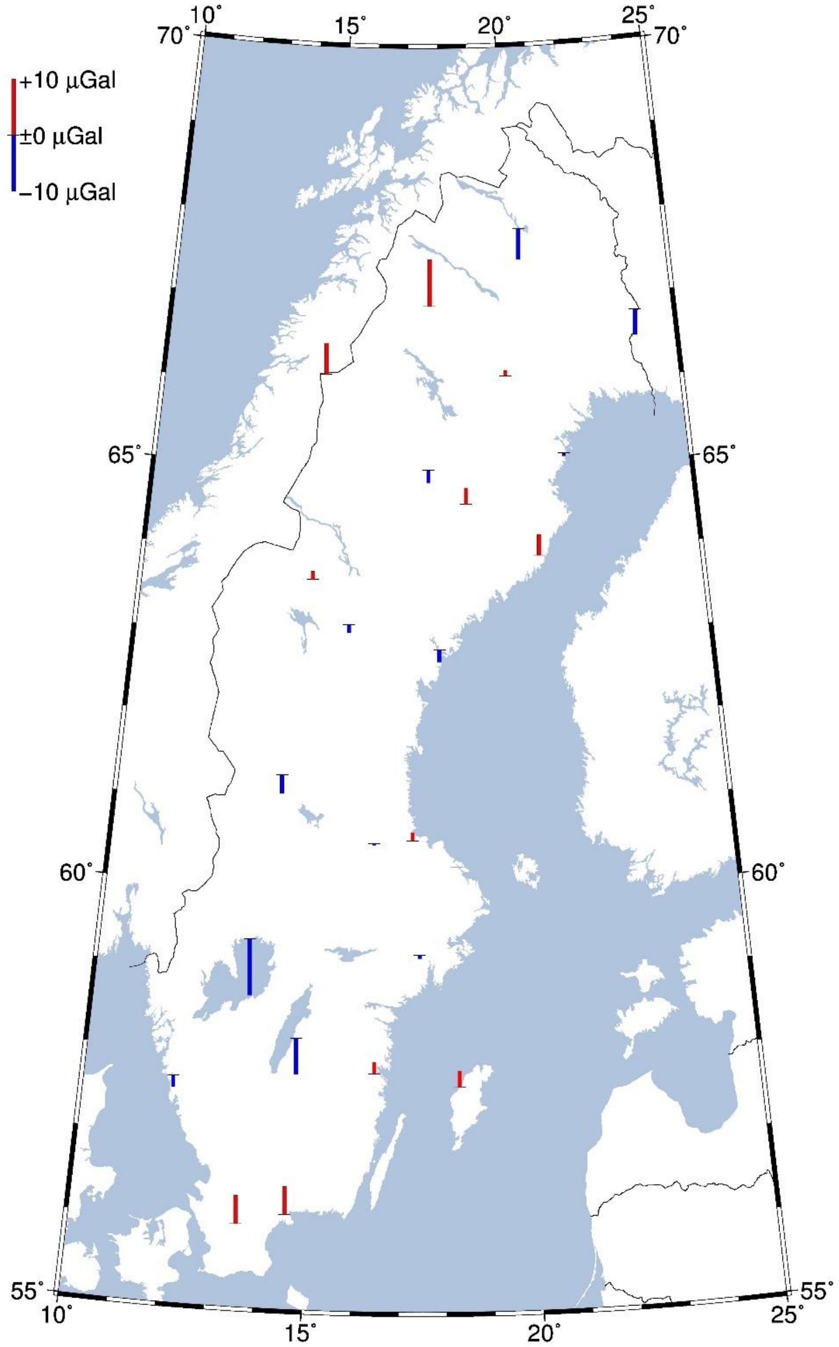

Figure 72: *Residuals in the inclined plane transformation between RG 82 and RG 2000 after correction for land uplift.*

The transformation was tested on all the 200 points included in the RG 82 network (see Table 32 in Appendix 2) and the standard uncertainty in one common point is 10.3 µGal (in regard to the 2018 realization of RG 2000). When the 24 points defining the transformation were removed from these 200 points, the new standard uncertainty in one common point is 10.9 µGal (see Figure 73).

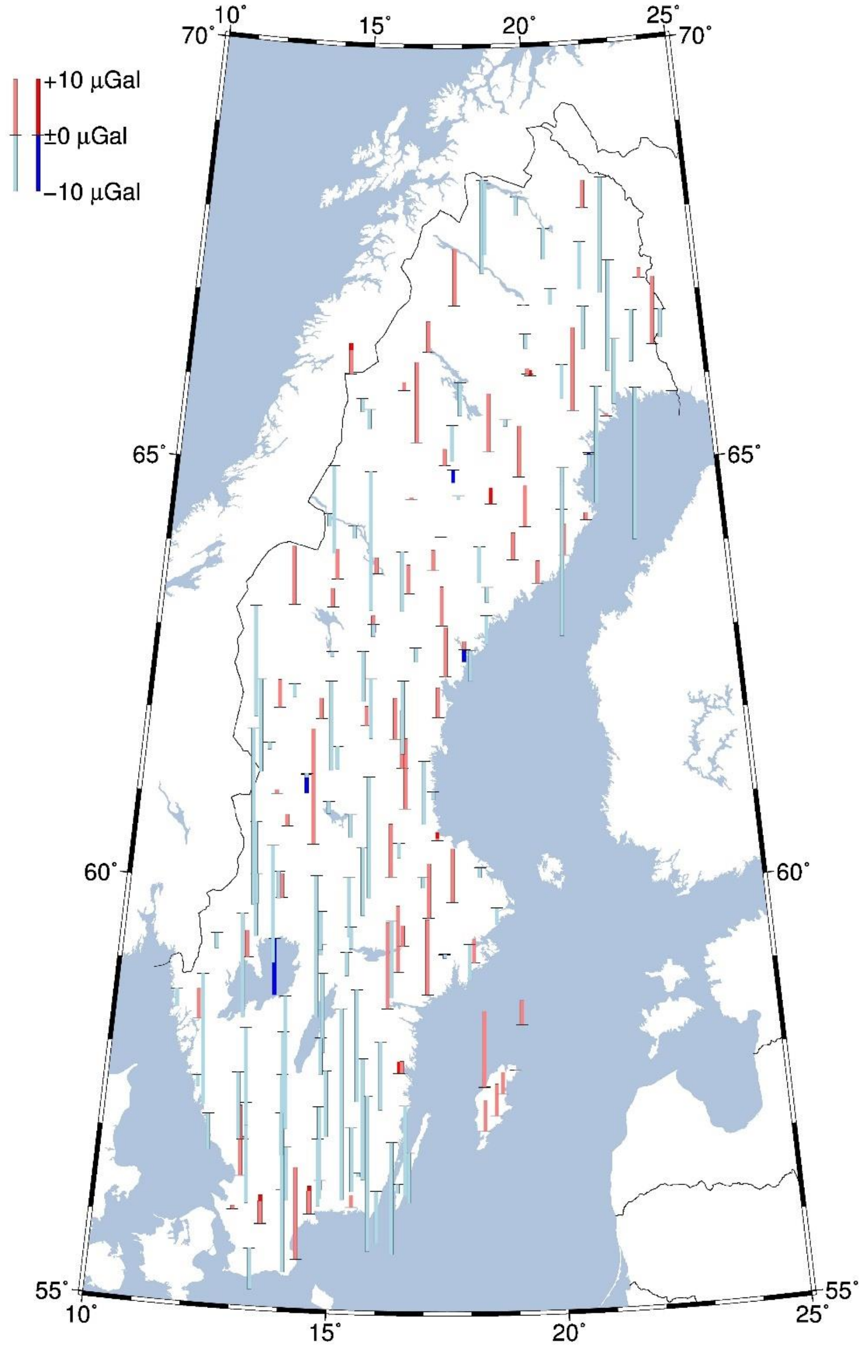

Figure 73: *Residuals in the inclined plane transformation between RG 82 and RG 2000 after correction for land uplift, for 200 points. Some larger errors in RG 82 can be found.*

12.1.3 Chosen transformation

The transformation in 12.1.2 has been chosen as the official connection between RG 82 and RG 2000.

12.1.4 The chosen transformation and the new realization

An important question to ask after the new realization was finished is if a new transformation between RG 82 and RG 2000 should be developed, i.e. if it has any significant meaning or not.

This was done via a test in the software Gtrans, where an adjustment was performed both with the transformed RG 82 values for the 24 used RG 82 Zero Order Network points and the RG 2000 values used to make this transformation (from the 2018 realization), and with the same transformed RG 82 values for the 24 used RG 82 Zero Order Network points and the RG 2000 values from the 2019 realization. The result can be seen in Table 20 below.

Table 20: *The difference between the chosen transformation and A) The 2018 realization of RG 2000 B) The 2019 realization of RG 2000.*

	A	B
Average (µGal)	0.0	0.7
RMS (µGal)	4.176	4.184
Max error (µGal)	10.1 Karlstad NA	8.7 Ödeshög NA

Table 20 shows that the result will be very similar and that it is not necessary to make a new transformation. The new realization fits better (despite the transformation is developed out of the old values) at Kvikkjokk NA, Kåbdalis AA, Stensele A, Lycksele A, Sävar AA, Föllinge A, Älvdalen A, Hofors A, Mårtsbo AA, Karlstad NA, Västervik NA, Visby NA, Höör A and Sölvesborg A. This means that it fits better at 14 of the 24 points and thus at all points which have absolute gravity observations except Kramfors AB.

Note that the input data for a new developed transformation for the new realization of RG 2000 with the same common points as in the chosen transformation would have been changed between -1.7 and 2.3 µGal per point, which would be only a very small impact to the transformation. This transformation would have become slightly better, with a standard uncertainty in one common point of 4.4 µGal.

12.1.5 Difference between RG 82 and RG 2000

The inclined plane transformation was combined with the land uplift correction between 1982 and 2000 and presented as a grid (see Figure 74). This grid represents the difference between RG 82 and RG 2000. The difference between RG 82 and RG 2000 is between -22 µGal to -62 µGal.

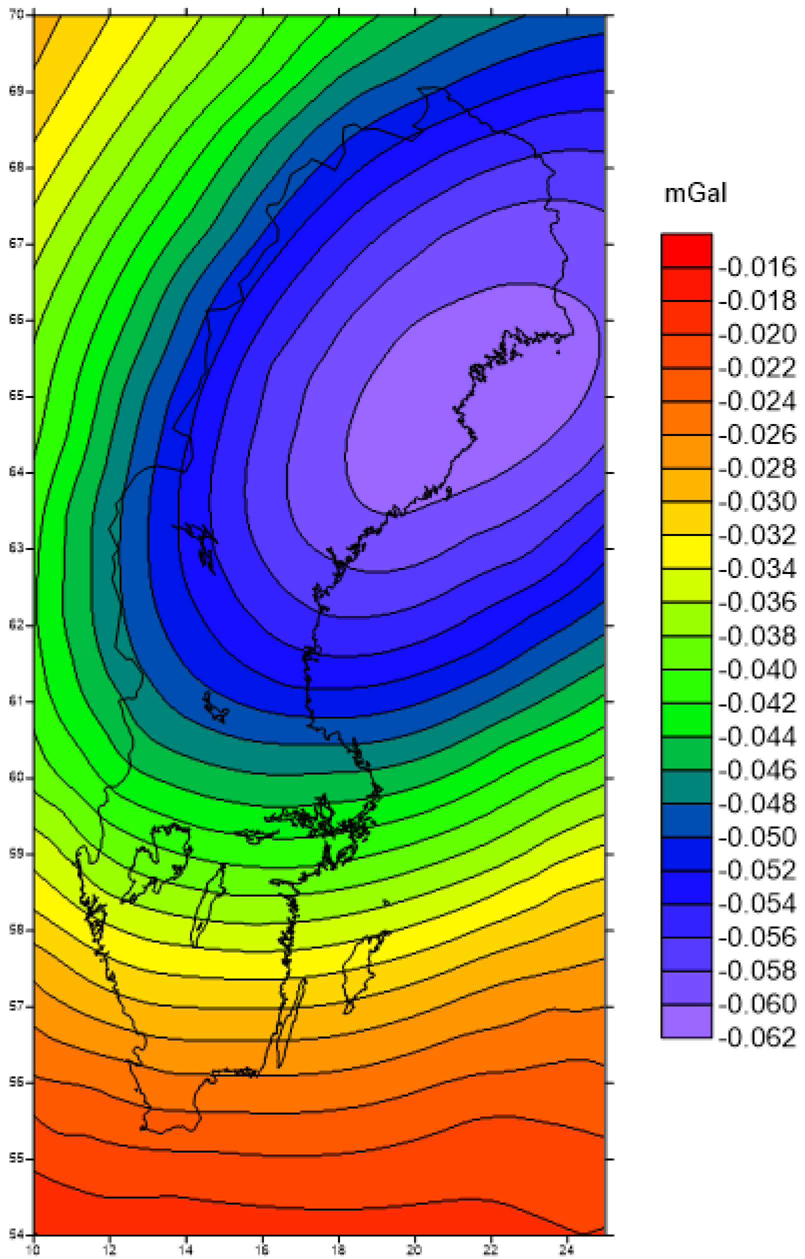

Figure 74: *The difference between RG 2000 and RG 82, the inclined plane transformation with the land uplift component included in the difference.*

12.2 Transformation RG 62 to RG 2000

In the year 2000, two transformations between RG 62 and RG 82 were developed. They were based on a by Lars Åke Haller hand-written sheet of paper with 28 different points which had values in both the systems. All the gravimeter readings / observations except for three points (Gudmundrå 1p, Hoting 1p and RAK 02 1p) have later been found in the protocol books. However, some of them were not properly calculated and some of the points have been remeasured with results that differed between 5 and 21 µGal. This was excluding the difference observed in Norra Ny 1p, which differed as much as 74 µGal. Still both the differences were observed by Lars Åke Haller.

The details about the transformations developed in 2000 can be read in *Engfeldt (2016a)*. One of the transformations was an inclined plane and the other transformation was a second-degree polynomial function. Of these, the polynomial function was found the best and was chosen as the official transformation between RG 62 and RG 82. Since then, this connection has been widely spread and used, for example, by SGU and in the Nordic database for geoid computations.

We have found four different ways to solve the transformation between RG 62 and RG 2000 and the different solutions are discussed in the Subsections 12.2.1-12.2.4. The statistics are summarized in Table 21, Subsection 12.2.5.

Note that there are some unrealistic features in RG 62 due to that it is very unevenly measured (see Appendix 3). Because of these, the transformation to much more consistent gravity systems, like RG 2000 and RG 82, is not so easy to handle.

12.2.1 Two step transformation, RG 62 to RG 82 via the old connection and RG 82 to RG 2000 via the inclined plane

The old transformation is developed in the Lantmäteriet software Gtrans, using the old Swedish reference system RT 90 2.5 gon V. The latter means that the planar coordinates are needed to be in that reference system in order to make the transformation work. The land uplift between the 20 years 1962 and 1982 is included in the transformation itself.

As mentioned in Subsection 12.1.2, the new official transformation between RG 82 and RG 2000 was developed in the Lantmäteriet software Gtrans and is an inclined plane. That transformation is using the coordinate system SWEREF 99 lat long, which means that the coordinates need to be transformed between RT 90 2.5 g V and SWEREF 99 lat long as a step in the middle. When the transformation was developed, the land uplift component was removed in advance. However, since then a grid was developed (see Subsection 12.1.5) where the land uplift component is included between the epochs 1982 and 2000. Hence, a user does not need to consider the land uplift while making this two-step transformation.

All residuals to the 2018 realization of RG 2000 are shown in Figure 75. For six points the residuals exceed 100 µGal, they are in order: Norsjö 1p 160.1, Övertorneå 1p 154.6, Arboga AA 146.7, Haparanda 1p 143.7, Morjärv 1p 118.3 and Bollnäs AA 105.9. More information about how the other points with an RG 2000 value from the main adjustment in 2018 fit with this transformation can be found in Table 43 in Appendix 3.

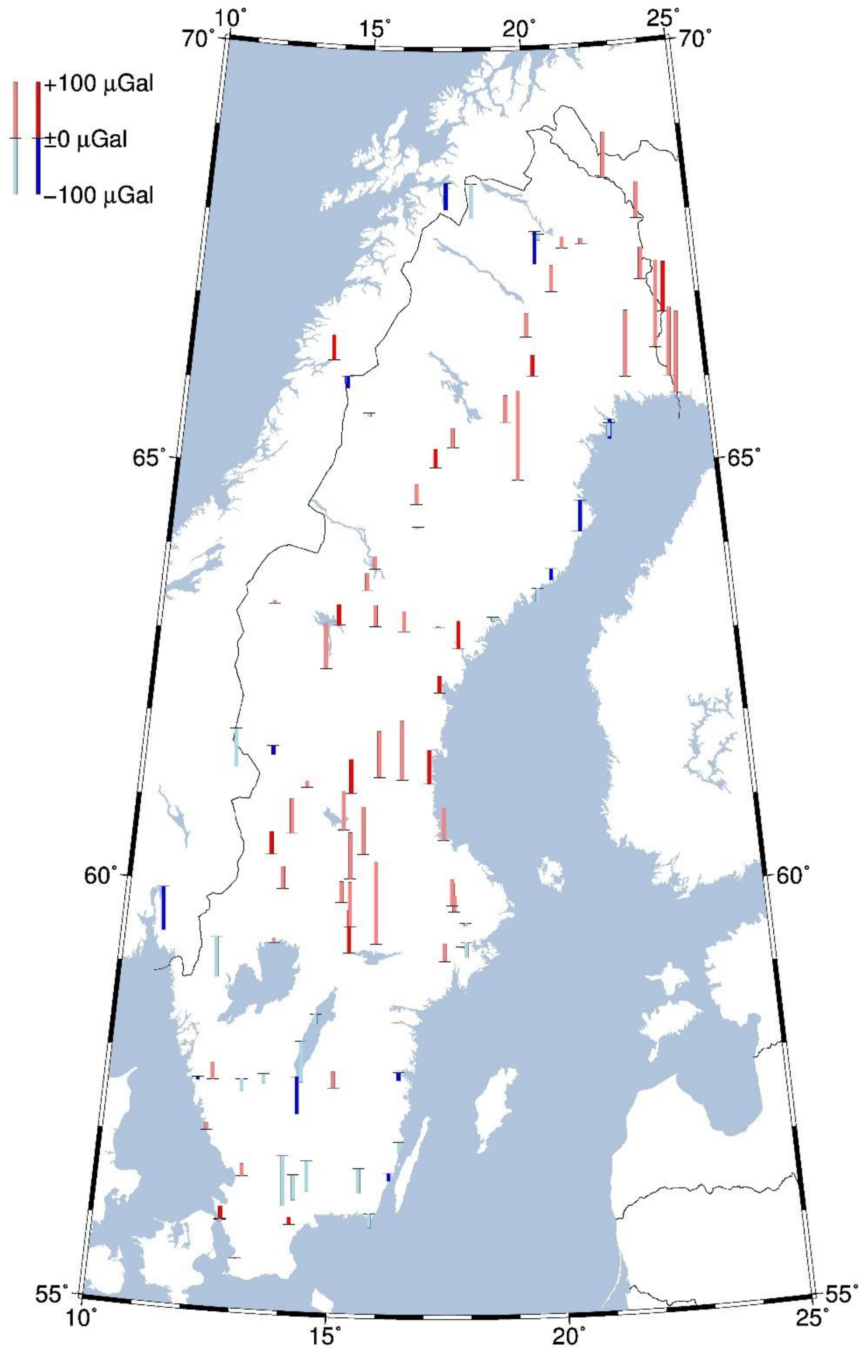

Figure 75: *Residuals in the two-step transformation between RG 62 and RG 2000 after correction for land uplift. The darker blue and darker red points are the points used for the old transformation between RG 62 and RG 82. The lighter blue and lighter red points are the other check points, where we have connections between the systems.*

12.2.2 Two step transformation, RG 62 to RG 82 via the a new better connection and RG 82 to RG 2000 via the inclined plane

Here, the transformation is developed in the Lantmäteriet software Gtrans using the reference system SWEREF 99 lat long. The latter means that the coordinates are needed to be in that system in order to make the transformation work. The land uplift between the 20 years 1962 and 1982 is not included in the transformation itself. Instead, the RG 62 values were corrected to epoch 1982.0 before making the transformation. The transformation was developed by using the 54 best connections we had, using the rest of the 39 connections just as checkpoints, as well as the two points we used in the connections in Subsection 12.2.3 and Subsection 12.2.4 where we only have g-values in RG 62 and RG 2000, but not in RG 82.

As mentioned in Subsection 12.1.2, the new official transformation between RG 82 and RG 2000 was developed in the Lantmäteriet software Gtrans and is an inclined plane. That transformation is also using the coordinate system SWEREF 99 lat long, which means that no coordinates need to be transformed as a step in the middle. The land uplift component was removed in advance.

All residuals to the 2018 realization of RG 2000 are shown in Figure 76.For five points the residuals exceed 100 µGal, they are in order: Norsjö 1p 119.7, Oslo A -115.8, Arboga AA 113.0, Bureå 1p -111.7 and Silbodal A 1p -110.3.

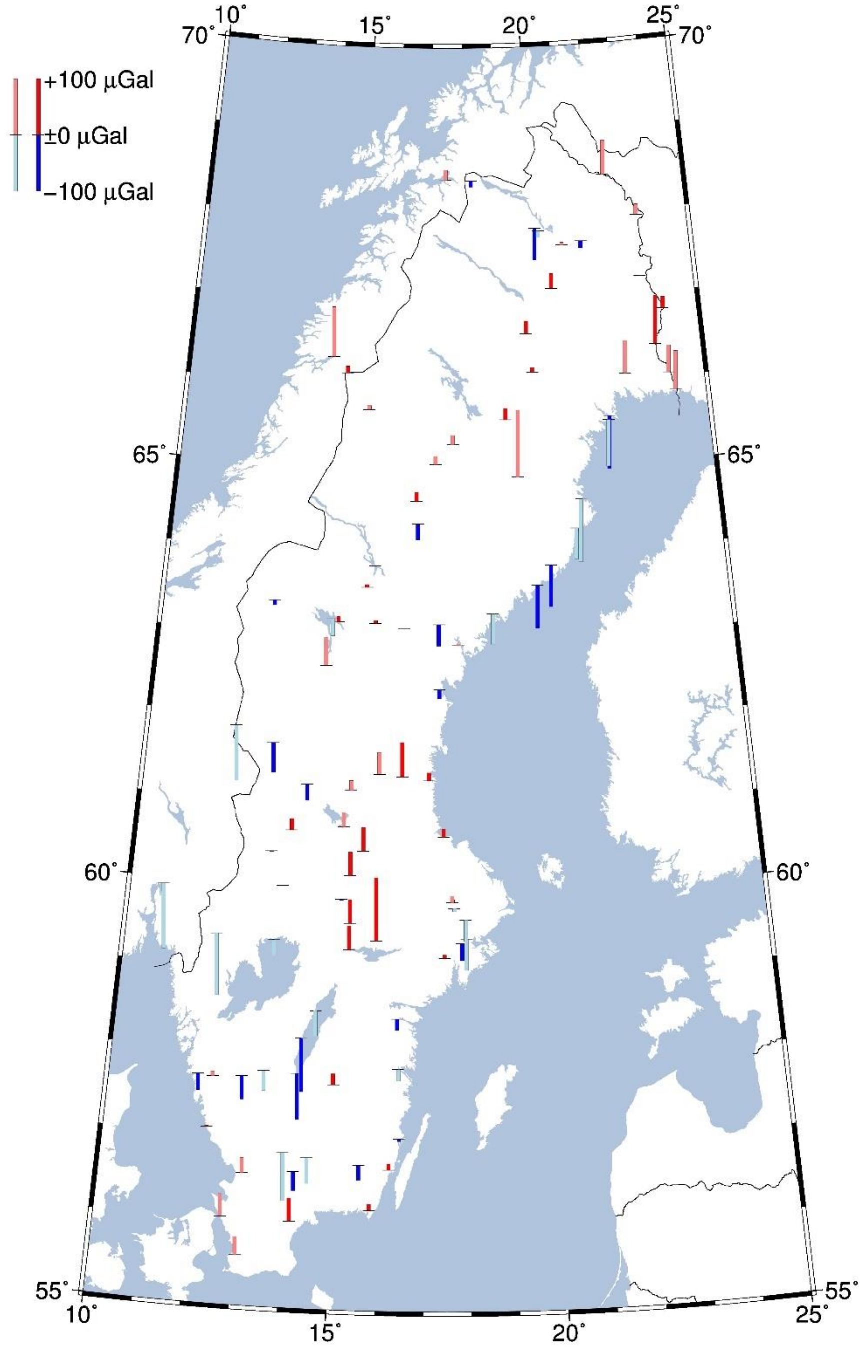

Figure 76: *Residuals in the improved two-step transformation between RG 62 and RG 2000 after correction for land uplift. The darker blue and darker red points are the points used for the new transformation between RG 62 and RG 82. The lighter blue and lighter red points are the other check points, where we have connections between the systems.*

12.2.3 Direct 1-parameter transformation RG 62 to RG 2000

Here, the transformation is developed in the Lantmäteriet software Gtrans using the reference system SWEREF 99 lat long. The latter means that the coordinates are needed to be in that system in order to make the transformation work. The land uplift between the 38 years 1962 and 2000 is not included in the transformation itself. Instead, the RG 62 values were corrected to epoch 2000.0 before making the transformation. If this transformation should have been our choice, we would have made a grid with the transformation parameters and the land uplift model together. The transformation was developed by using the 56 best connections we had, using the rest of the 39 connections just as checkpoints.

All residuals to the 2018 realization of RG 2000 are shown in Figure 77. For 26 points the residuals exceed 100 µGal, they are in order: Haparanda 1p 200.1, Övertorneå 1p 197.2, Norsjö 1p 194.4, Ljungby 1p -191.7, Karungi 1p 173.7, Morjärv 1p 160.2, Vislanda 1p -157.3, Stenbrohult 1p -154.5, Bulltofta 1p -150.0, Algutsboda 1p -145.6, Jämjö 1p -145.2, Jönköping 1p -139.4, Helsingborg B 1p -137.3, Södra Fågelås 1p -133.5, Pello 1p 125.0, Arboga AA 122.8, Vassijaure 1p -121.6, Oslo A -120.5, Bollnäs AA 117.8, Kristianstad 1p -117.5, Silbodal A 1p -115.9, Narvik -115.6, Dörby 1p -115.1, Helsingborg A 1p -110.6, Mönsterås 1p -107.3 and Borås 1p -101.6.

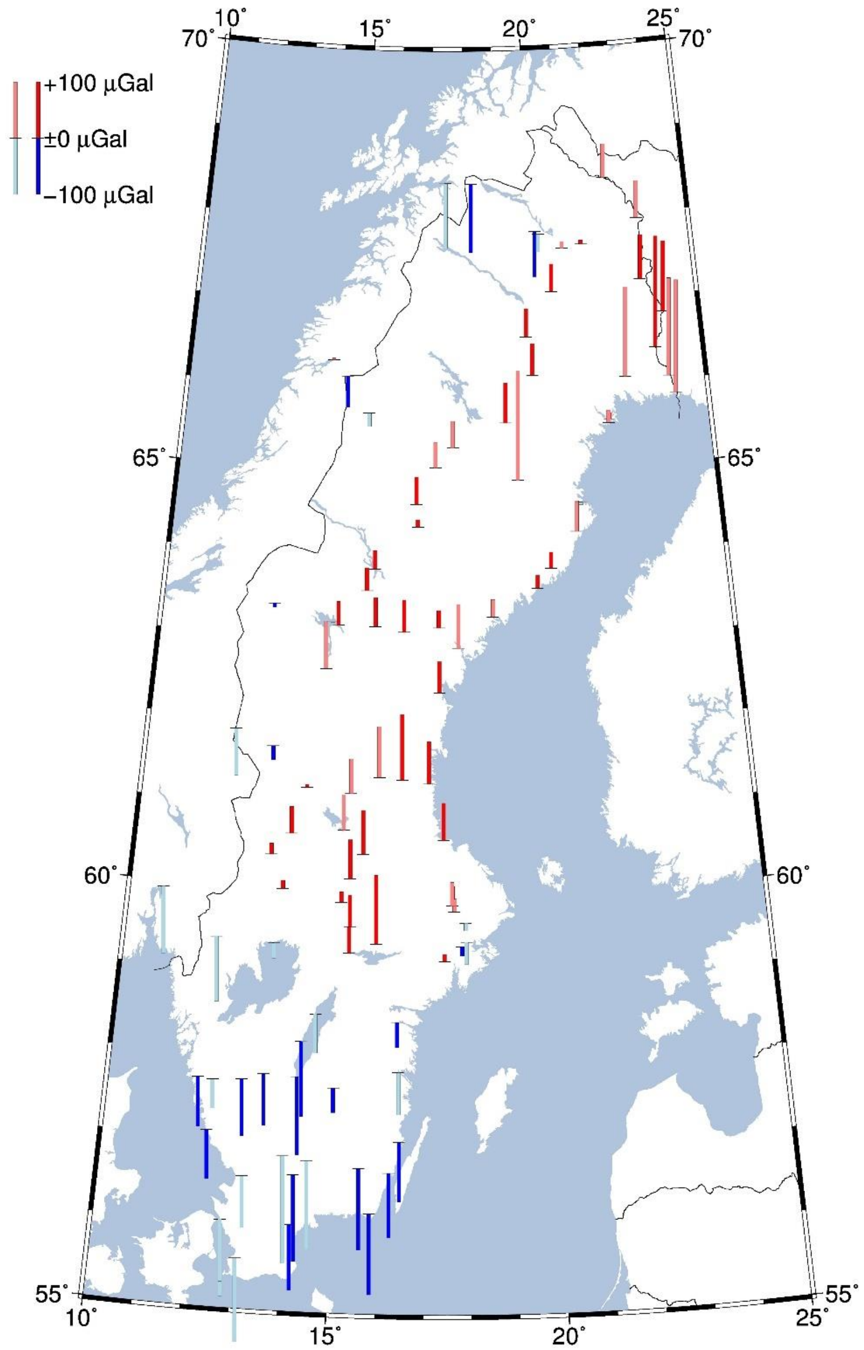

Figure 77: *Residuals in the 1-parameter transformation between RG 62 and RG 2000 after correction for land uplift. The darker blue and darker red points are the points used for the transformation. The lighter blue and lighter red points are the other check points, where we have connections between the systems.*

12.2.4 Direct transformation RG 62 to RG 2000 via a second degree polynomial function

Here, the transformation is developed in the Lantmäteriet software Gtrans, using the reference system SWEREF 99 lat long. The latter means that the coordinates are needed to be in that system in order to make the transformation work. The land uplift between the 38 years 1962 and 2000 is not included in the transformation itself. That is why the RG 62 values were corrected to epoch 2000.0 before making the transformation. If this transformation should have been our choice, we would have made a grid with the transformation parameters and the land uplift model together. The transformation was developed by using the 56 best connections we had, using the rest of the 39 connections just as checkpoints.

All residuals to the 2018 realization of RG 2000 are shown in Figure 78. For three points the residuals exceed 100 µGal, they are in order: Norsjö 1p 120.0, Arboga AA 114.4 and Bureå 1p -113.9. Oslo A is -99.3.

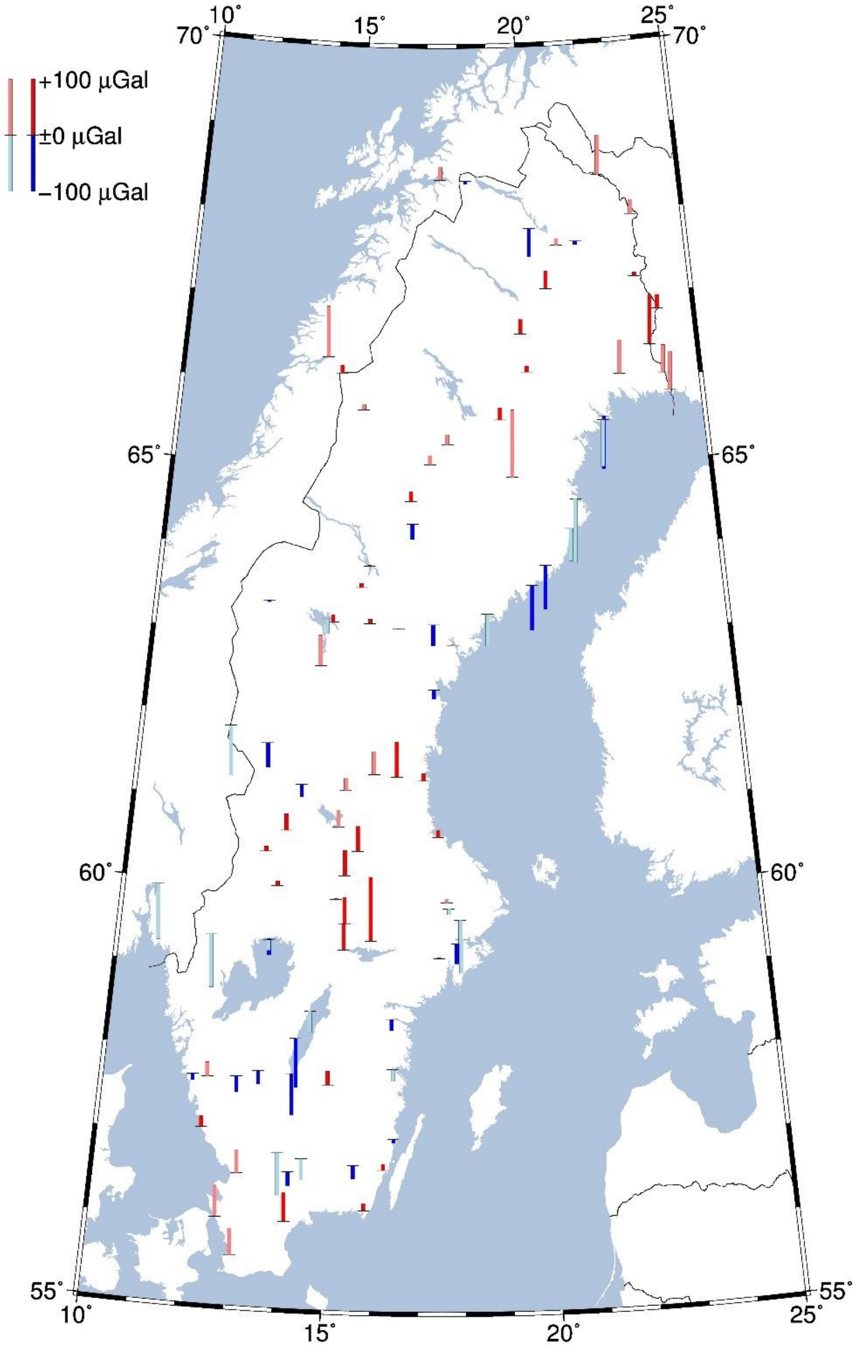

Figure 78: *Residuals in the transformation with the second-degree polynomial function between RG 62 and RG 2000 after correction for land uplift. The darker blue and darker red points are the points used for the transformation. The lighter blue and lighter red points are the other check points, where we have connections between the systems.*

12.2.5 Chosen transformation

The method in Subsection 12.2.1 is called Method 1, the method in Subsection 12.2.2 is called Method 2 etc. Table 21 is showing the statistics for these methods.

Table 21: *Statistics for the different methods, 95 points included (in µGal).*

Method	Average	Std dev	RMS
Method 1	20.0	53.7	57.0
Method 2	-4.0	47.7	47.6
Method 3	-0.7	88.1	87.6
Method 4	0.0	47.7	47.4

Since the old transformation between RG 62 and RG 82 already is in use and some end-users as well as data providers (NKG database) have used it for their transformation, changing the transformation would lead to problems and could cause misunderstandings. If the difference between this transformation (Method 1) and the best transformation (see Subsection 12.2.6 and Table 22) had been very large in comparison to the needed accuracy for what the result is used for, the decision would have been another. In 2018, we have decided that Method 1 is the method to use. Despite the new data has given us a better connection we have now decided to keep the old chosen transformation. After the new realization of RG 2000 in 2019 was made, the whole RG 62 network has values in RG 2000. Figure 79 shows an update of Figure 75, which actually looks better.

For six points in Sweden the residuals exceed 100 µGal, they are in order: Norsjö 1p 160.1, Övertorneå 1p 154.6, Arboga AA 146.7, Haparanda 1p 143.7, Morjärv 1p 118.3 and Bollnäs AA 105.9. Note that there are three points in Narvik (Norway) and there seems to be gross errors for one of them, Narvik L 1p (the railway station).

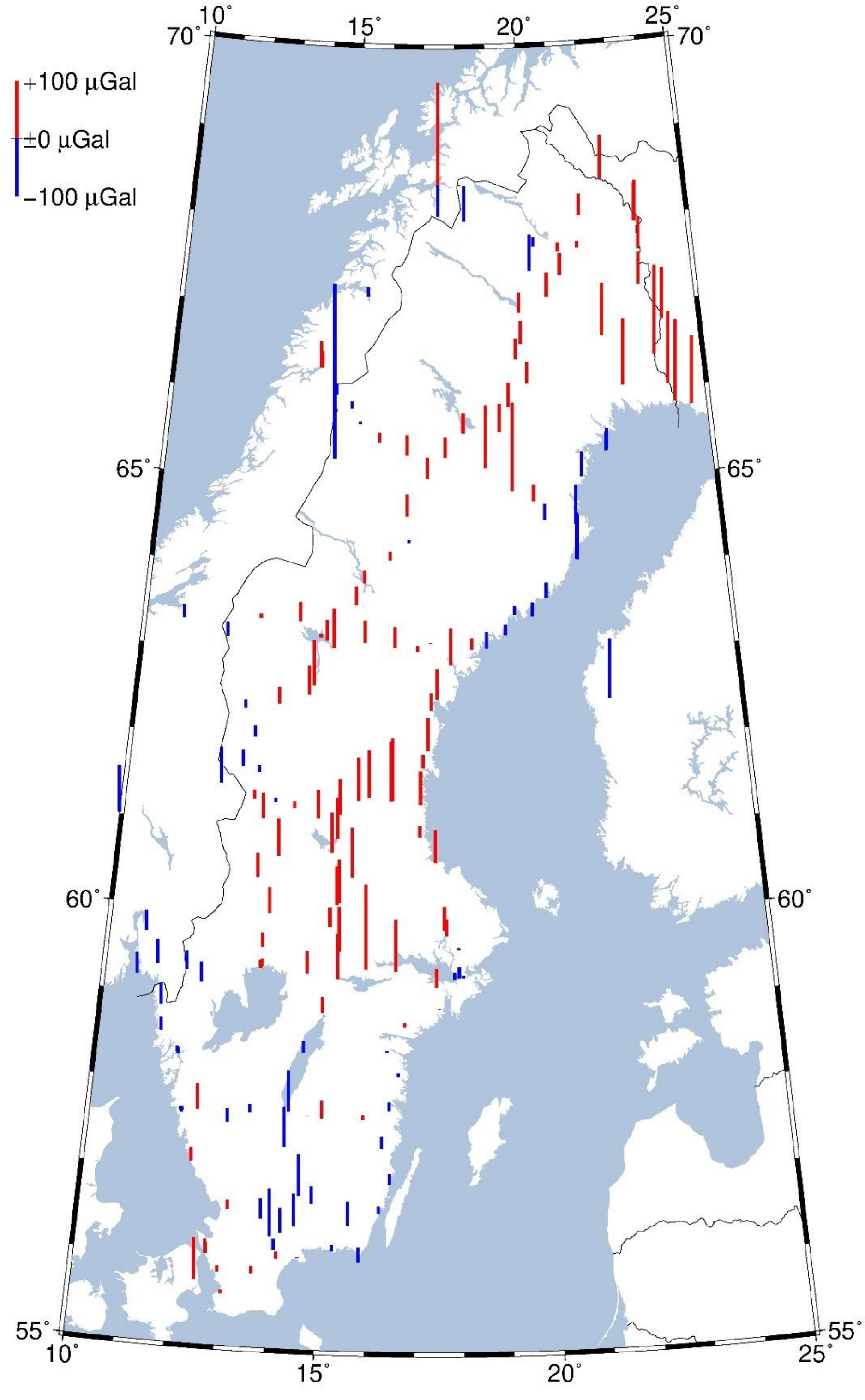

Figure 79: *Residuals in the two-step transformation between RG 62 and RG 2000 (2019 realization) after correction for land uplift for all RG 62 points.*

12.2.6 Transformation tests after the 2019 realization of RG 2000 was done

In the second step of the 2019 realization of RG 2000 all main points and all spare points in RG 62 got values in RG 2000. Therefore, it was interesting to investigate how good the transformation would be with so many more connections between the systems than available in the previous transformations. Three possibilities were tested: An inclined plane transformation, a second-degree polynomial function transformation and finally a fourth-degree polynomial function. For all of these, 12 points were excluded, the outliers Arboga AA, Bollnäs AA, Bollnäs Åsen 1p, Kiruna A 1p, Ljungby 1p, Norsjö 1p, Vassijaure 1p, Bodø A, Bodø B, Narvik J and Narvik K and the off-area situated Koivulahti. It means that 188 points were used for the transformations. All the transformations were one-step transformations directly between RG 62 and RG 2000, without the middle step RG 82.

The result was, as suspected, that the more complicated the method the better the fit, see Table 22. Note that all outliers were included in the statistics here, except the two points in Bodø.

Table 22: *A) Inclined plane B) second-degree polynomial function C) fourth-degree polynomial function D) The chosen solution, see Subsection 12.2.1. The result is shown both including all points and including only points situated in Sweden.*

Method	A	B	C	D
Standard Dev (All)	54.7	45.4	38.3	48.7
Mean Dev (All)	41.6	33.5	26.9	38.0
Standard Dev (Swe)	52.6	42.8	35.1	46.0
Mean Dev (Swe)	40.5	31.7	24.9	36.2

It is worth mentioning that there were a few areas where Method B was better than Method C, for example in the north and east part of Jämtland and between Arvidsjaur 1p and Svappavaara 1p.

There were also a few places where Method A was the best method, for example between København and Göteborg and between Stockholm and Arlanda.

Note that it is not possible to directly compare the outlier statistics below to the same statistics in 12.2.1-12.2.4, since there are more points included here. It should also be mentioned that none of the points in Bodø and the points Fauske, Narvik and Koivulahti were counted due to the large gross errors. Still, the points in Sweden with gross errors are included, since they were included also in 12.2.1-12.2.4.

For Method A, for ten points the residuals exceed 100 µGal, they are in order: Bjørnfjell 175.2, Vassijaure 1p 151.3, Arboga AA -150.5, Kiruna A 1p 139.0, Norsjö 1p -133.8, Mo i Rana 119.7, Bollnäs AA -117.3, Övertorneå 1p -110.5, Ljungby 1p 109.0 and Haparanda 2 1p -108.3. For Method B, for five points the residuals exceed 100 µGal, they are in order: Arboga AA -127.4, Bureå 1p 122.8, Byske 1p 112.1, Norsjö 1p -111.2 and Övertorneå 1p -105.8. For Method C, for two points the residuals exceed 100 µGal, they are in order: Norsjö 1p -137.0 and Arboga AA -126.6.

If this is compared to the solution in 12.2.5, all these methods have three advantages. First, the coordinate systems are not mixed as in the second-step transformation (where the transformation between RG 62 and RG 82 is in RT 90 2.5 gon V and the transformation between RG 82 and RG 2000 is in SWEREF 99 lat long). Second, the old coordinate system RT 90 2.5 gon V is not needed at all. Third, method 2 and method 3 both give a better overall result than the transformation in 12.2.5. The solution in 12.2.5 has two advantages. First, that we use the old official transformation between RG 62 and RG 82 which has been used for almost 20 years and for all our gravity points measured before the year 2000 and the new official transformation between RG 82 and RG 2000. Second, that a grid is already developed for this transformation.

Finally, the difference between RG 62 and RG 2000 was also calculated for all the RG 62 points. The average value is 14.68 mGal and the difference is shown in Figure 80 and in Table 15 (in Subsection 10.5.1).

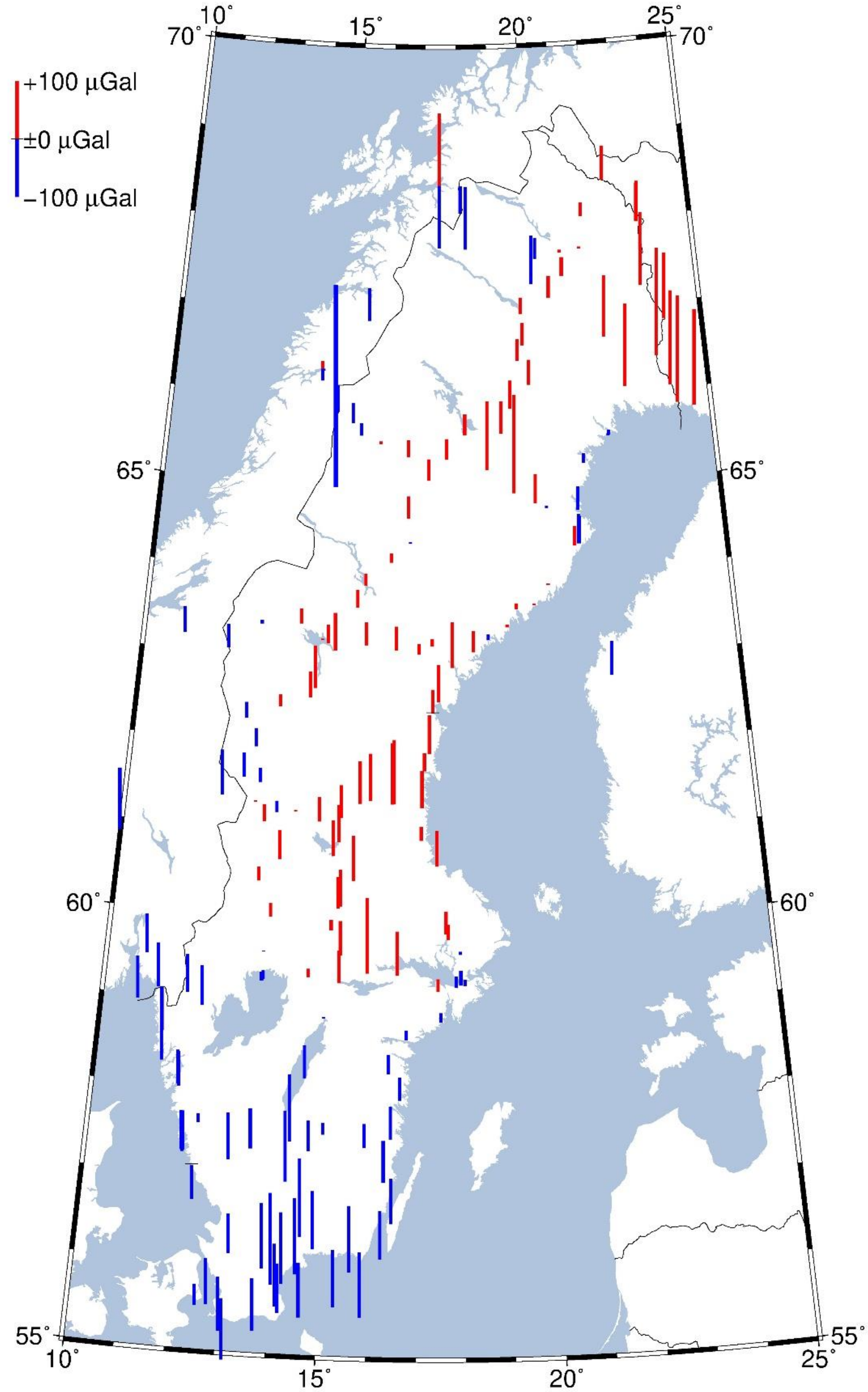

Figure 80: Compare to Figure 77. *Residuals between RG 62 and RG 2000. The factor 14.68 mGal has been subtracted in order to get values to show in a figure.*

13 Summary

RG 2000 is the new gravity reference frame in Sweden. It is based on absolute gravity observations with the instrument FG5 on 18 points (Class A points) at 14 different stations. It also includes 95 points (Class B points) observed with A10 and connected with the relative gravimeter types Scintrex CG5 and LCR model G to the Class A points and/or 230 Class C points, the latter observed only with relative gravimeters. 148 more points are classified (Class D) and were included in a second order adjustment.

The postglacial epoch of RG 2000 is 2000.0 and the land uplift model NKG2016LU_gdot has been used. This model is based on the land uplift model NKG2016LU_abs and has used the factor -0.163 µGal/m to convert the metres into mGal. Transformations have been developed to the two previous gravity systems of Sweden, RG 82 and RG 62.

So far, two official realizations of the gravity frame have been developed and the realization from 2019 is the one we use currently. In the future, more official realizations may be developed, when the land uplift models will get better or when new important gravity points will be established (like new points for FG5).

Acknowledgements

Thanks to everyone who has participated in the RG 2000 project in some way or the other.

The photographs are taken by the author except Figure 12 right and 49 right by Holger Steffen, Figure 20 left by Per Nyfeldt, Figure 40 right by Gabriel Strykowski, Figure 46 by Ludger Timmen and Figure 55 by Mikael Lilje. Figure 2, 4, 6, 59, 60, 61, 62, 63, 64, 65, 66, 68, 69, 70, 71, 72 and 73 are drawn by Per-Anders Olsson, Figure 1, 51, 52, 53, 54, 55, 56, 57 and 58 are drawn by Per-Anders Olsson from a script by Holger Steffen, Figure 74 is drawn by Jonas Ågren and Figure 3 is taken from *Vestøl et al (2019)*.

Thanks to Lennart Pettersson for observing half of the RG 82 Zero Order Network, observing along the land uplift gravity lines, observing some additional points and observing almost the whole RG 62 Network; Lars Åke Haller for observing half of the RG 82 Zero Order Network Network, observing about a fourth of the RG 82 First Order Network Network, observing along the land uplift gravity lines and observing some additional points; Ludger Timmen and Olga Gitlein for performing several very long FG5 campaigns with FG5-220; Marcin Sekowski and Przemyslaw Dykowski for being the main operators of A10-020; Jens Emil Nielsen for being the operator of A10-019; Håkan Skatt for observing about a fifth of the RG 82 First Order Network and observing along the 63rd degree land uplift line; All other observers along the land uplift gravity lines; The other members (except Ludger Timmen, Olga Gitlein and myself) of the FG5-233 or FG5-220 gravity teams no matter if they have functioned as main operators or just assistants (hopefully no one forgotten): Per-Anders Olsson, Geza Lohasz, Holger Steffen, Jonas Ågren, Fredrik Dahlström, Jakob Jansson, Linda Ahlm, Robert Odolinski, Johan Sunna, Martin Lidberg, Runar Svensson, Jan Lindström, Örjan Josefsson, Mikael Lilje, Christina Lilje, Tina Kempe, Jonatan Mälstam, Manuel Schilling, Klaus Lindner, Walter Zürn, Matthias Kneschke, Matthias Ruhle, Hendrik Ernst and Peter Witte.

Thanks to Holger Steffen, in particular, and Per-Anders Olsson and Örjan Josefsson for reading this manuscript and coming with several good ideas of how to make it better. Thanks to Jonas Ågren, Martin Lidberg, Jaakko Mäkinen and Hannu Ruotsalainen for lots of discussion and good advices. Thanks to Ludger Timmen for lots of discussion and excellent co-operation during the two 30 days FG5 campaigns in 2004-05. Thanks to Marcin Sekowski and Przemyslaw Dykowski for excellent co-operation during the A10 campaigns. Thanks to Gabriel Strykowski for good discussions, for sending me the modern absolute gravity value of København Buddinge and excellent co-operation during the 56th degree land uplift gravity campaigns in 2003 and 2012. Thanks to Jens Emil Nielsen for excellent co-operation during the 56th degree land uplift gravity campaign in 2012. Thanks to Henrik Bryskhe for writing the code to the software. Thanks to Jyri Näränen for lots of discussion and excellent company during many intercomparisons. Thanks to Dagny Lysaker for sending me the modern absolute gravity values of Oslo A and Bodø A. Thanks to all people who have observed with FG5-233 with me during the years, it has been a pleasure working with you.

References

Boedecker, G., 1988*: International absolute gravity basestation network (IAGBN) – absolute gravity observations data processing standards and station documentation*. BGI Bull d'Inf 63:51-56.

Cannizzo, L., Cerutti, G., 1978: *Absolute-Gravity measurements in Europe*. Il Nuovo Cimento Vol 1C, N.1, January-February 1978, 39-85.

Ekman, M., 2009: *The changing level of the Baltic Sea during 300 years: A Clue to Understanding the Earth.* Summer Institute for Historical Geophysics, Åland Islands, ISBN 978-952-92-5241-1.

Ekman, M., Olsson, P.-A., 2017: *Gravity Determinations at the Observatories in Uppsala and Stockholm during three Centuries.* Summer Institute for Historical Geophysics, Åland Islands, Small Publications in Historical Geophysics No. 30.

Engfeldt, A., 2016a: *RG 2000 – status March 2016*. Lantmäterirapport 2016:1. (https://www.lantmateriet.se/sv/Kartor-och-geografisk-information/GPS-och-geodetisk-matning/Om-geodesi/Rapporter-och-publikationer/Lantmaterirapporter/ , sited 2018-02-19)

Engfeldt, A., 2016b: *Preparations and plans for the new national gravity system, RG 2000*. Lantmäterirapport 2016:2.

Engfeldt, A., Lidberg, M., Sekowski, M., Dykowski, P., Krynski, J., Ågren, J., Olsson, P.-A., Bryskhe, H., Steffen, H., Nielsen, J. E., Strykowski, G., 2019: R*G 2000 – the new gravity reference frame of Sweden*. Geophysica (2019), 54(1), 69-92.

Francis, O., et al., 2010: *Results of the European Comparison of Absolute Gravimeters in Walferdange (Luxembourg) of November 2007.* Gravity, Geoid and Earth Observation vol 135, ed S P Mertikas (Berlin: Springer) pp 31-5.

Francis, O., et al., 2013: *The European Comparison of Absolute Gravimeters 2011 (ECAG-2011) in Walferdange, Luxembourg: results and recommendations*. Metrologia 50, no. 3 (2013): 257.

Francis, O., et al., 2014: *CCM.G-K2 Key Comparison. Metrologia* **52** 07009 doi:10.1088/0026-1394/52/1A/07009.

Gantar, C., Morelli, C., 1962: *Measurements with gravity-meters along the Northern part of the European Calibration Line; Bad Harzburg – Bodø.* Bollettino de Geofisica teorica ed applicata, Vol IV, N.15 – Settembre 1962

Gitlein, O., 2009: *Absolutgravimetrische Bestimmung der Fennoskandischen Landhebung mit dem FG5-220,* Wissenschaftliche Arbeiten der Fachrichtung Geodäsie und Geoinformatik der Leibniz Universität Hannover, Nr 281.

Haller, L. Å., Ekman, M., 1988: *The fundamental gravity network of Sweden.* LMV-rapport 1988:16.

Jansson, P., Norin, D., 1990: *Gravimetry*. Diploma work KTH, TRITA Geod 3017.

Jiang, Z., et al., 2012: *The 8th International Comparison of Absolute Gravimeters 2009: the first Key Comparison (CCM.G-K1) in the field of absolute gravimetry.* Metrologia 49, no. 6 (2012): 666.

Kempe C., Jivall L., Lidberg M., Lilje M., 2016 *On the Management of Reference Frames in Sweden.* FIG Working Week, 2-6 May 2016, Christchurch, New Zeeland.

(https://www.fig.net/resources/proceedings/fig_proceedings/fig2016/papers/ts02b/TS02B_kempe_jivall_et_al_8179.pdf , sited 2018-02-19)

Kierulf, H.P., Steffen, H., Simpson, M.J.R., Lidberg, M., Wu, P., Wang, H., 2014: *A GPS velocity field for Fennoscandia and a consistent comparison to glacial isostatic adjustment models.* J. Geophys. Res. Solid Earth 119, 6613–6629.

Kiviniemi, A., 1974: *High precision measurements for studying the secular variation in gravity in Finland*. Publ. Finn. Geodet, Inst., 78.

Koch, K.-R., 2000: *Parameter Estimation and Hypothesis Testing in Linear Models*. 2a Updated and Enlarged Edition, Springer 2000.

Křen, P., Pálinkáš, V., Mašika, P., 2018: *On the determination of verticality and Eötvös effect in absolute gravimetry*. Metrologia May 2018 DOI: 10.1088/1681-7575/aac522.

LaCoste & Romberg, 2004: “Instruction Manual Model G&D Gravity Meters,” Austin, Texas, USA.

Lantmäteriet, 2010: *Geodesy 2010, a strategic plan for Lantmäteriet’s geodetic activities 2010-2020*. (http://www.lantmateriet.se/globalassets/kartor-och-geografisk-information/gps-och-matning/geodesi/rapporter_publikationer/publikationer/geodesy_2010.pdf , sited 2018-02-19)

Micro-g LaCoste, 2008: *A10 portable gravimeter user's manual*. Micro-g LaCoste, Lafayette, Colorado, USA.

Micro-g LaCoste, 2012: *g9 User's Manual. Micro-g LaCoste*, Lafayette, Colorado, USA.

Micro-g LaCoste, 2006: *FG5-X gravimeter user's manual*. Micro-g LaCoste, Lafayette, Colorado, USA.

Mäkinen, J., Ekman, M., Midtsundstad, Å., Remmer, O., 1986: *The Fennoscandian land uplift gravity lines 1966-1984.* FGI report 85:4.

Mäkinen, J., Engfeldt, A., Harsson, B.G., Ruotsalainen, H., Strykowski, G., Oja, T., Wolf, D., 2005: *The Fennoscandian land uplift gravity lines 1966-2003.* In: Jekeli, C., Bastor, L., Fernandes, J. (Eds), Gravity, Geoid and Space Missions, vol 129 of International Association of Geodesy Symposia. Springer, Berlin, Heidelberg, pp. 328-332

Mäkinen J., Sękowski M., Kryński J., 2010: *The use of the A10-020 gravimeter for the modernization of the Finnish First Order Gravity Network*, Geoinformation Issues, Vol. 2, No 1, str. 5-17.

Niebauer, T.M., Sasagawa, G.S., Faller, J.E., Hilt, R., Klopping, F., 1995: *A new generation of absolute gravimeters*. Metrologia 32, 159-180.

Olsson, P.-A., Engfeldt, A., Ågren, J., 2015a: *Investigations of a suspected jump in Swedish repeated absolute gravity time series.* IUGG 2015, proceedings.

Olsson, P.-A., Milne, G., Scherneck, H.-G., Ågren, J., 2015b: *The relation between gravity rate of change and vertical displacement in previously glaciated areas.* Journal of Geodynamics (83), pp 76-84.

Olsson, P.-A., Breili, K., Ophaug, V., Steffen, H., Bilker-Koivula, M., Nielsen, E., Oja, T., Timmen, L., 2019: *Postglacial gravity change in Fennoscandia: Three decades of repeated absolute gravity observations.* Geophysical Journal International 217, 1141–1156, doi:10.1093/gji/ggz054.

Pálinkáš, V., et al., 2017: *EURAMET.M.G-K2 Key Comparison.* Metrologia, 54(1A), 07012, doi:10.1088/0026-1394/54/1a/07012.

Persson, C.-G., 1982: *Utjämning, analys och optimering av triangelnät.* Föredrag vid 9 Nordiska geodetmötet i Gävle 1982, pp 215-230.

Pettersson, L., 1967: *The Swedish first order gravity network.* Rikets Allmänna Kartverk, Meddelande nr A 35.

Schilling, M., Timmen, L., 2016: *Traceability of the Hannover FG5X-220 to the SI units.* International Symposium on Earth and Environmental Sciences for Future Generation, pp 69-75, doi 10.1007/1345_201.

Smith, V., 2018: *Extracting geodetic useful information from absolute gravimetry at fundamental geodetic station.* Doctoral thesis (PhD), UCL (University Collage London).

Timmen, L., Engfeldt, A., Scherneck H-G., 2015: *Observed secular gravity trend at Onsala station with the FG5 gravimeter from Hannover.* J Geodetic Sci 5(1):18-25, doi: 10.1515/jogs-2015-0001.

Timmen, L., Wenzel, H.-G., 1995: *Worldwide synthetic gravity tide parameters*, Gravity and geoid, pp 92-101.

Vestøl, O., Ågren, J., Steffen, H., Kierulf, H.P., Tarasov, L., 2019: NKG2016LU – a new land uplift model for Fennoscandia and the Baltic Region. J. Geodesy 93(9), 1759–1779, doi:10.1007/s00190-019-01280-8.

Wideland, B., 1946: *Relative Schweremessungen in Süd- und Mittelschweden in den Jahren 1943-1944.* Rikets Allmänna Kartverk Meddelande Nr 6.

Wideland, B., 1951: *Relative gravity measurements in middle and north Sweden 1945-1948.* Rikets Allmänna Kartverk Meddelande Nr 14.

Ågren, J., Sjöberg, L.E., 2014: *Investigations of Gravity Data Requirements for a 5 mm Quasigeoid Model over Sweden. Gravity, Geoid and Height Systems,* Proceedings of the IAG Symposium GGHS2012, October 9-12, 2012, Venice, Italy, pp 143-150.

Appendix 1, points in RG 2000

Here are all points included in the main adjustment of RG 2000, first with their short names (included in Table 24 with the observed sequences in Appendix 2, their full names and their class, then with some information about what kind of point is originally was and when it was observed and with which instruments.

Aamot, Åmot, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2016 and in 2017.

Aannn, Ånn, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2001. Observed with G54 and CG5-1184 in 2016.

AarAA, Årjäng AA, Class B. Previously used as an RG 82 First Order Network point. Observed with A10-020 in 2011. Observed with G54 and G290 in 1985. Observed with CG5-740 in 2011. Observed with G54 and CG5-1184 in 2016.

Aatee, Åte, Class C. Previously used as an RG 82 First Order Network point, nowadays a spare point to Örnsköldsvik AA. Observed with G54 and G290 in 2002.

AlbAA, Älvsbyn AA, Class B. Observed with A10-020 in 2015. Observed with G54 and CG5-1184 in 2015.

Albyy, Alby, Class C, but destroyed. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002.

Alg1p, Algutsboda 1p, Class C. Previously used as an RG 62 point, nowadays a spare point to Emmaboda AA. Observed with G54 and CG5-1184 in 2016.

AlmAA, Älmhult AA, Class B. Observed with A10-020 in 2012. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2016.

AlvAA, Älvdalen AA, Class B. Previously used as an RG 62 point. Observed with A10-020 in 2012. Observed with G54 and G290 in 1996. Observed with G54 and G290 in 2001. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2015.

AlvdA, Älvdalen A, Class C. Previously used as a main point along the 61st degree land uplift gravity line and an RG 82 Zero Order Network main point, nowadays a spare point to Älvdalen AA. Observed with several LCR instruments in 1976 and in 1983. Observed with G54 and G290 in 1981 and in 1982. Observed with G54 and G290 in 1996. Observed with G54 and G290 in 2001. Observed with G54 and CG5-1184 in 2015.

AlvdB, Älvdalen B, Class C. Previously used as an RG 82 Zero Order Network spare point, nowadays a spare point to Älvdalen AA. Observed with several LCR instruments in 1976.

Alvsb, Älvsbyn, Class C. Previously used as an RG 82 First Order Network point, nowadays a spare point to Älvsbyn AA. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2015.

Ammar, Ammarnäs, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2001.

Aneby, Aneby, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2017.

ArbAA, Arboga AA, Class B. Previously used as an RG 62 point. Observed with A10-020 in 2011. Observed with CG5-740 in 2011. Observed with G54 and CG5-1184 in 2016 and in 2017.

Arbra, Arbrå, Class C. Previously used as an RG 82 First Order Network point, nowadays a spare point to Bollnäs AA. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2015.

ArjAA, Arjeplog AA, Class A, see Subsection 2.4.7. Observed with G54 and G290 in 2004. Observed with G54 and CG5-1184 in 2016. Observed with CG5-1184 in 2017.

ArjAB, Arjeplog AB, Class B. Observed with A10-020 in 2013. Observed with G54 and CG5-1184 in 2016. Observed with CG5-1184 in 2017.

ArjeF, Arjeplog B, Class C. Spare point to Arjeplog AA. Observed with CG5-1184 in 2017.

Arjep, Arjeplog, Class C. Previously used as an RG 82 First Order Network point, nowadays a spare point to Arjeplog AB. Observed with G54 and G290 in 2001. Observed with G54 and CG5-1184 in 2016.

ArvAA, Arvidsjaur AA, Class B. Observed with A10-020 in 2013. Observed with CG5-740 2013. Observed with G54 and CG5-1184 in 2015 and in 2016.

Arvid, Arvidsjaur, Class C, but half destroyed. Previously used as an RG 82 First Order Network point, nowadays a spare point to Arvidsjaur AA if the marker is not fully destroyed. Observed with G54 and G290 in 2001. Observed with G54 and CG5-1184 in 2015.

Arvik, Arvika, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 1990. Observed with G54 and CG5-1184 in 2016.

Arv1p, Arvidsjaur 1p, Class C. Previously used as an RG 62 point, nowadays a spare point to Arvidsjaur AA. Observed with CG5-1184 in 2015.

AseAA, Åsele AA, Class B. Observed with A10-020 in 2012 and in 2015. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2015.

Aseda, Åseda, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2015.

Asele, Åsele, Class C. Previously used as an RG 82 First Order Network point, nowadays a spare point to Åsele AA. Observed with G54 and G290 in 1992.

Astor, Åstorp, Class C. Previously used as an RG 82 First Order Network point, nowadays a spare point to Helsingborg AA. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2016.

Atvid, Åtvidaberg, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2017.

AugAA, Augerum AA, Class B. Observed with A10-020 in 2012. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2016.

Avest, Avesta, Class C. Previously used as an RG 82 First Order Network point, nowadays a spare point to Grytnäs AA. Observed with G54 and G290 in 2001. Observed with G54 and CG5-1184 in 2015 and in 2016.

BalAA, Baltak AA, Class B. Observed with A10-020 in 2015. Observed with G54 and CG5-1184 in 2015 and in 2016.

BBrAA, Boda Bruk AA, Class B. Previously used as an RG 82 First Order Network point. Observed with A10-020 in 2012 and in 2013. Observed with G54 and G290 in 2002. Observed with CG5-740 in 2012 and in 2013. Observed with G54 and CG5-1184 in 2016.

Bergn, Bergnäset, Class C. Previously used as an RG 82 First Order Network point, nowadays a spare point to Luleå AA. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2015 and in 2016.

BjoNA, Björkliden NA, Class C. Previously used as an RG 82 Zero Order Network main point, nowadays a spare point to Björkliden NB. Observed with G54 and G290 in 1981, in 1982 and in 1985.

BjoNB, Björkliden NB, Class C. Previously used as an RG 82 Zero Order Network spare point, nowadays the main point in Björkliden. Observed with G54 and G290 in 1985. Observed with CG5-740 in 2014. Observed with G54 and CG5-1184 in 2016.

Bjorn, Björna, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002.

BjuAA, Bjurholm AA, Class B. Previously used as an RG 82 First Order Network point. Observed with A10-020 in 2012. Observed with G54 and G290 in 2002.

Bloms, Blomstermåla, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2016.

Bodaa, Boda, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002.

Bofor, Bofors, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 1990.

BolAA, Bollnäs AA, Class B. Previously used as an RG 62 point. Observed with A10-020 in 2012. Observed with G54 and CG5-740 in 2012. Observed with G54 and CG5-1184 in 2015 and in 2017.

BorAA, Borås AA, Class A, see Subsection 2.3.13. Observed with G54 and CG5-740 in 2013. Observed with CG5-740 in 2014. Observed with G54 and CG5-1184 in 2017.

Boras, Borås, Class C. Previously used as an RG 82 First Order Network point, nowadays a spare point to Borås AA. Observed with G54 and G290 in 2002. Observed with G54 and CG5-740 in 2013. Observed with CG5-740 in 2014. Observed with G54 and CG5-1184 in 2017.

Borgh, Borgholm, Class C. Previously used as an RG 82 First Order Network point, nowadays spare point to Köpingsvik AA. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2016.

Borla, Borlänge, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2001. Observed with G54 and CG5-1184 in 2015 and in 2017.

Bor1p, Borås 1p, Class C. Previously used as an RG 62 point, nowadays a spare point to Borås AA. Observed with G54 and CG5-740 in 2013.

Bottn, Bottnaryd, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2016.

BrgAA, Borgsjö AA, Class B. Observed with A10-020 in 2015. Observed with G54 and CG5-1184 in 2015.

Bunge, Bunge, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 1984.

BurAA, Bureå AA, Class B. Observed with A10-020 in 2013. Observed with CG5-740 in 2013. Observed with G54 and CG5-1184 in 2015 and in 2016. Observed with CG5-1184 in 2017.

Burtr, Burträsk, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2001. Observed with G54 and CG5-1184 in 2016.

Dalaa, Dala, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2015 and in 2016.

Dalby, Dalby, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2016.

DalsE, Dals-Ed, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 1985. Observed with G54 and CG5-1184 in 2015.

Dor1p, Dörby 1p, Class C. Previously used as an RG 62 point, nowadays a spare point to Ljungbyholm AA. Observed with CG5-1184 in 2016.

DuvAA, Duved AA, Class B. Observed with A10-020 in 2012. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2016.

Edefo, Edefors, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002.

EksAA, Eksjö AA, Class B. Previously used as an RG 62 point. Observed with A10-020 in 2012. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2016 and in 2017.

Eksha, Ekshärad, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 1985. Observed with G54 and CG5-1184 in 2016.

EmmAA, Emmaboda AA, Class B. Previously used as an RG 82 First Order Network point. Observed with A10-020 in 2012. Observed with G54 and G290 in 2002. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2016.

Enkop, Enköping, Class C, but hard to get access to. Previously used as an RG 82 First Order Network point, nowadays a spare point to Svinnegarn AA. Observed with G54 and G290 in 1990.

Eskil, Eskilstuna, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 1990. Observed with G54 and CG5-1184 in 2016.

FlkAA, Falkenberg AA, Class B. Observed with A10-020 in 2015. Observed with G54 and CG5-1184 in 2015.

FollA, Föllinge A, Class C. Previously used as a main point along the 63rd degree land uplift gravity line and an RG 82 Zero Order Network main point. Observed with several LCR instruments in 1979-2003. Observed with G54 and G290 in 1981 and in 1982. Observed with G54 and G290 in 1992.

FollB, Föllinge B, Class C. Previously used as an RG 82 Zero Order Network spare point, nowadays still a spare point to Föllinge A. Observed with G54 and G290 in 2004. Observed with CG5-198 in 2008.

FreAA, Fredriksberg AA, Class B. Previously used as an RG 82 First Order Network point. Observed with A10-020 in 2013. Observed with G54 and G290 in 1990. Observed with CG5-740 in 2014. Observed with G54 and CG5-1184 in 2016.

Fredr, Fredrika, Class C and half destroyed. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 1992.

FryAA, Fryksände AA, Class B. Observed with A10-020 in 2011. Observed with CG5-740 in 2011. Observed with G54 and CG5-1184 in 2016.

Gadde, Gäddede, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 1992.

GalAA, Gällivare AA, Class B. Previously used as an RG 62 point. Observed with A10-020 in 2013. Observed with CG5-740 in 2013. Observed with G54 and CG5-1184 in 2015 and in 2016.

Galli, Gällivare, Class C. Previously used as an RG 82 First Order Network point, nowadays a spare point to Gällivare AA. Observed with G54 and G290 in 2001. Observed with G54 and CG5-1184 in 2015.

GamAA, Gamleby AA, Class B. Observed with A10-020 in 2012. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2016 and in 2017.

Garde, Garde, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 1984. Observed with G54 and CG5-1184 in 2017.

Gnarp, Gnarp, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2016.

GoteA, Göteborg A, Class C. Previously used as an RG 82 Zero Order Network spare point, nowadays still a spare point to Göteborg NB. Observed with G54 in 1980.

Gothe, Gothem, Class C, but not reachable anymore. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 1984.

GotNB, Göteborg NB, Class C. Previously used as an RG 82 Zero Order Network main point. Observed with G54 and G290 in 1981 and in 1982. Observed with G54 and G290 in 1985 and in 2002. Observed with G54 and CG5-740 in 2013.

Gotsk, Gotska Sandön, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 1984.

Got1p, Göteborg 1p, Class C. Previously used as an RG 62 point, nowadays a spare point to Göteborg NB. Observed with G54 and G290 in 1982.

GriAA, Grinneröd AA, Class B. Observed with A10-020 in 2012. Observed with CG5-740 in 2012. Observed with G54 and CG5-740 in 2013.

Grotl, Grötlingbo, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 1984.

GryAA, Grytnäs AA, Class B. Observed with A10-020 in 2013. Observed with CG5-740 in 2014. Observed with G54 and CG5-1184 in 2015, in 2016 and in 2017.

Gryth, Grythyttan, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 1990. Observed with G54 and CG5-1184 in 2017.

Gulse, Gulsele, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2015.

Hakka, Hakkas, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2016.

Halls, Hallstahammar, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 1990. Observed with G54 and CG5-1184 in 2016 and in 2017.

Hallv, Hallviken, ClassC. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 1992. Observed with G54 and CG5-1184 in 2016.

HamAA, Hammerdal AA, Class B. Previously used as an RG 62 point. Observed with A10-020 in 2012. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2015 and in 2016.

HapAA, Haparanda AA, Class B. Observed with A10-020 in 2015. Observed with G54 and CG5-1184 in 2015 and in 2016.

Hapar, Haparanda, Class C. Previously used as an RG 82 First Order Network point, nowadays a spare point to Haparanda AA. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2015.

HarAA, Härnösand AA, Class B. Observed with A10-020 in 2015. Observed with G54 and CG5-1184 in 2015.

HedAA, Hede AA, Class B. Observed with A10-020 in 2012. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2016 and in 2017.

Hedee, Hede, Class C. Previously used as an RG 82 First Order Network point, nowadays a spare point to Hede AA. Observed with G54 and G290 in 2001. Observed with G54 and CG5-1184 in 2016 and in 2017.

HelAA, Helsingborg AA, Class B. Observed with A10-020 in 2012. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2016.

Hemav, Hemavan, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2001. Observed with G54 and CG5-1184 in 2016.

Hem1p, Hemse 1p, Class C. Previously used as an RG 82 First Order Network point, nowadays a spare point to Grötlingbo. Observed with G54 and G290 in 1984.

Hille, Hillerstorp, Class B. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2016.

HofoA, Hofors A, Class C, but destroyed. Previously used as a main point along the 61st degree land uplift gravity line and an RG 82 Zero Order Network main point. Observed with several LCR instruments in 1976 and in 1983. Observed with G54 and G290 in 1980, 1981 and in 1982.

HofoB, Hofors B, Class C. Previously used as an RG 82 Zero Order Network spare point, nowadays the main (and only) point in Hofors. Observed with several LCR instruments in 1976. Observed with G54 and G290 in 2001. Observed with G54 and CG5-1184 in 2016.

HolAA, Holmsund AA, Class A, see Subsection 2.4.14. Observed with A10-020 in 2012. Observed with FG5X in 2019. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2015.

HonAA, Hörnefors AA, Class B. Previously used as an RG 82 First Order Network point. Observed with A10-020 in 2012. Observed with G54 and G290 in 2002. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2015.

Hon1p, Hörnefors 1p, Class C. Previously used as an RG 62 point, nowadays a spare point to Hörnefors AA. Observed with CG5-1184 in 2015.

HooAA, Höör AA, Class B. Observed with A10-019 in 2012.Observed with G290, CG5-740 and two Danish CG5s in 2012.

HoorA, Höör A, Class C. Previously used as a main point along the 56th degree land uplift gravity line and an RG 82 Zero Order Network main point, nowadays a spare point to Höör AA. Observed with several LCR instruments in 1977 and in 1984. Observed with G54 and G290 in 1981 and in 1982.

HoorB, Höör B, Class C. Previously used as a main point along the 56th degree land uplift gravity line and an RG 82 Zero Order Network spare point, nowadays a spare point to Höör AA. Observed with several LCR instruments in 1975.

Observed with G54 and G290 in 2002. Observed with G54 and G378 in 2003. Observed with G54 and G290 in 1981 and in 1982.

Hotin, Hoting, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 1992. Observed with G54 and CG5-1184 in 2016.

HunAA, Hundsjön AA, Class B. Previously used as an RG 82 First Order Network point. Observed with A10-020 in 2013. Observed with G54 and G290 in 2002. Observed with CG5-740 in 2013. Observed with G54 and CG5-1184 in 2016.

HusAA, Husby-Ärlinghundra AA, Class B. Observed with A10-020 in 2012. Observed with CG5-740 in 2013 and in 2014. Observed with G54, CG5-740 and CG5-1184 in 2015. Observed with G54 and CG5-1184 in 2016. Observed with CG5-1184 in 2017. Observed with CG5-198 and CG5-1184 in 2019.

Hyboo, Hybo, Class C. Previously used as an RG 82 First Order Network point, nowadays a spare point to Ljusdal AA. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2016.

Idree, Idre, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2001. Observed with G54 and CG5-1184 in 2016.

Jakkv, Jäkkvik, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2001. Observed with CG5-1184 in 2017.

Jam1p, Jämjö 1p, Class C. Previously used as an RG 62 point, nowadays a spare point to Augerum AA. Observed with G54 and CG5-1184 in 2016.

Jarpe, Järpen, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2001. Observed with CG5-198 in 2008. Observed with G54 and CG5-1184 in 2016.

JavNA, Jävre NA, Class C. Previously used as an RG 82 Zero Order Network main point. Observed with G54 and G290 in 1981, in 1982, in 1985 and in 2004. Observed with CG5-1184 in 2017.

JavNB, Jävre NB, Class C. Previously used as an RG 82 Zero Order Network spare point, nowadays still a spare point to Jävre NA. Observed with G54 and G290 in 1985, in 2001 and in 2002. Observed with CG5-1184 in 2017.

Johan, Johannishus, Class C. Previously used as an RG 82 First Order Network point, nowadays a spare point to Augerum AA. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2016.

Jokkm, Jokkmokk, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2001. Observed with G54 and CG5-1184 in 2016.

Jok1p, Jokkmokk 1p, Class C. Previously used as an RG 62 point, nowadays a spare point to Jokkmokk. Observed with CG5-1184 in 2016.

Jon1p, Jönköping 1p, Class C. Previously used as an RG 62 point. Observed with G54 and G290 in 1983.

Jordb, Jordbro, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 1990. Observed with G54 and CG5-1184 in 2017.

JukNA, Jukkasjärvi NA, Class C. Previously used as an RG 82 Zero Order Network main point. Observed with G54 and G290 in 1981, in 1982 and in 1985. Observed with G54 and G290 in 2001, in 2002 and in 2004.

JukNB, Jukkasjärvi NB, Class C. Previously used as an RG 82 Zero Order Network spare point, nowadays still a spare point to Jukkasjärvi NA. Observed with G54 and G290 in 1985.

JunAA, Junsele AA, Class B. Observed with A10-020 in 2015. Observed with G54 and CG5-1184 in 2015.

Junos, Junosuando, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2016.

KabAA, Kåbdalis AA, Class B. Previously used as an RG 82 Zero Order Network main point with the name Kåbdalis NA. Observed with A10-020 in 2013. Observed with G54 and G290 in 1981 and in 1982. Observed with G54 and G290 in 2001. Observed with CG5-740 in 2012.

KabNB, Kåbdalis NB, Class C. Previously used as an RG 82 Zero Order Network spare point, nowadays still a spare point to Kåbdalis AA. Observed with G54 and G290 in 1985.

Kab1p, Kåbdalis 1p, Class C. Previously used as an RG 62 point, nowadays a spare point to Kåbdalis AA. Observed with G54 and G290 in 1982.

Kalix, Kalix, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2016.

KarAA, Karlstad AA, Class B. Observed with A10-020 in 2011. Observed with CG5-740 in 2011. Observed with G54 and CG5-1184 in 2016.

Kares, Karesuando, Class C. Previously used as an RG 82 First Order Network point, nowadays a spare point to Karesuando AA. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2015.

KarNA, Karlstad NA, Class C. Previously used as an RG 82 Zero Order Network main point, nowadays a spare point to Karlstad AA. Observed with G54 and G290 in 1981 and in 1982. Observed with G54 and G290 in 1985 and in 1990. Observed with G54 and CG5-1184 in 2016.

Kastl, Kastlösa, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2016.

KirAA, Kiruna AA, Class A, see Subsection 2.4.4. Observed with G54 and G290 in 2004. Observed with G54 and CG5-1184 in 2015.

Kisaa, Kisa, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2015 and in 2016.

KliAA, Klimpfjäll AA, Class B. Observed with A10-020 in 2012. Observed with CG5-740 in 2012. Observed with CG5-198 and CG5-740 in 2014. Observed with G54 and CG5-1184 in 2015. Observed with CG5-198, CG5-740 and CG5-1184 in 2019.

KloAA, Klöveskog AA, Class B. Observed with A10-020 in 2015. Observed with G54 and CG5-1184 in 2015 and in 2017.

KopAA, Köpingsvik AA, Class B. Observed with A10-020 in 2012. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2016.

Korpi, Korpilombolo, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002.

KraAA, Kramfors AA, Class A, see Subsection 3.3.5. Observed with G45, G54, G290 and G378 in 2003. Observed with CG5-198 in 2008. Observed with CG5-1184 in 2016.

KraAB, Kramfors AB, Class B. Previously used as a main point along the 63rd degree land uplift gravity line and an RG 82 Zero Order Network main point with the name Kramfors D. Observed with A10-020 in 2012. Observed with several LCR instruments in 1972-2003. Observed with G54 and G290 in 1981 and in 1982. Observed with G54 and G290 in 2002. Observed with CG5-198 in 2008. Observed with CG5-740 in 2012.

KramA, Kramfors A, Class C. Previously used as an RG 82 Zero Order Network spare point, nowadays a spare point to Kramfors AA and Kramfors AB. Observed with several LCR instruments in 1972. Observed with G54 and G290 in 1981 and in 1982.

KramB, Kramfors B, Class C. Previously used as an RG 82 Zero Order Network spare point, nowadays a spare point to Kramfors AA and Kramfors AB. Observed with several LCR instruments in 1972.

KramC, Kramfors C, Class C. Previously used as an RG 82 Zero Order Network spare point, nowadays a spare point to Kramfors AA and Kramfors AB. Observed with several LCR instruments in 1972.

KrdAA, Kärda AA, Class B. Observed with A10-020 in 2012. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2016.

Kroko, Krokom, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2001. Observed with CG5-198 in 2008. Observed with G54 and CG5-1184 in 2016.

KsuAA, Karesuando AA, Class B. Observed with A10-020 in 2013. Observed with CG5-740 in 2013. Observed with G54 and CG5-1184 in 2015.

KviNA, Kvikkjokk NA, Class C. Previously used as an RG 82 Zero Order Network main point, nowadays the spare point to Kvikkjokk NB. Observed with G54 and G290 in 1981, in 1982 and in 1985.

KviNB, Kvikkjokk NB, Class C. Previously used as an RG 82 Zero Order Network spare point, nowadays the main point in Kvikkjokk. Observed with G54 and G290 in 1985 and in 2001.

Lafor, Laforsen, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2017.

Lagan, Lagan, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2016 and in 2017.

Lahol, Laholm, Class C. Previously used as an RG 82 First Order Network point, nowadays a spare point to Veinge AA. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2016 and in 2017.

Lansa, Lansån, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2016.

LaxAA, Laxå AA, Class B. Previously used as an RG 82 First Order Network point. Observed with A10-020 in 2012. Observed with G54 and G290 in 1990. Observed with CG5-740 in 2012.

LekAA, Leksand AA, Class B. Observed with A10-020 in 2013. Observed with CG5-740 in 2014. Observed with G54 and CG5-1184 in 2015 and in 2016.

Lidtr, Lidträsk, Class C. Previously used as an RG 82 First Order Network point, nowadays a spare point to Skellefteå AA. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2016.

Linde, Lindesberg, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 1990. Observed with G54 and CG5-1184 in 2016.

Lin1p, Lindesberg 1p, Class C. Previously used as an RG 62 point, nowadays a spare point to Lindesberg. Observed with G54 and CG5-1184 in 2016.

LjbAA, Ljungbyholm AA, Class B. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2016.

LjdAA, Ljusdal AA, Class B. Observed with A10-020 in 2013. Observed with CG5-740 in 2014. Observed with G54 and CG5-1184 in 2016 and 2017.

LjfAA, Ljusfallshammar AA, Class B. Previously used as an RG 82 First Order Network point. Observed with A10-020 in 2012. Observed with G54 and G290 in 2002. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2016.

LjuAA, Ljusnarsberg AA, Class B. Previously used as an RG 62 point. Observed with A10-020 in 2011. Observed with CG5-740 in 2011. Observed with G54 and CG5-1184 in 2016 and in 2017.

LMVAA, LMV AA, Class A, see Subsection 3.3.10. Observed with CG5-740 in 2012, in 2013 and in 2014. Observed with G54, CG5-740 and CG5-1184 in 2015. Observed with G54 and CG5-1184 in 2016 and in 2017. Observed with CG5-198 and CG5-1184 in 2019.

Lofsd, Lofsdalen, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2001. Observed with G54 and CG5-1184 in 2017.

Lonne, Lönneberga, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2016 and in 2017.

Lovan, Lövånger, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002. Observed with CG5-1184 in 2017.

Ludvi, Ludvika, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 1990. Observed with G54, CG5-198 and CG5-1184 in 2019.

Lud1p, Ludvika 1p, Class C. Previously used as an RG 62 point, nowadays a spare point to Ludvika. Observed with G54 and CG5-1184 in 2017. Observed with G54, CG5-198 and CG5-1184 in 2019.

LulAA, Luleå AA, Class B. Previously used as an RG 62 point. Observed with A10-020 in 2013. Observed with CG5-740 in 2013. Observed with G54 and CG5-1184 in 2015.

LycAA, Lycksele AA, Class A, see Subsection 3.3.12. Observed with G54 and CG5-1184 in 2015 and in 2016. Observed with CG5-1184 in 2019.

LyckA, Lycksele A, Class C. Previously used as a main point along the 65th degree land uplift gravity line and an RG 82 Zero Order Network main point, nowadays a spare point to Lycksele AA. Observed with several LCR instruments in 1975 and in 1980. Observed with G54 and G290 in 1981 and in 1982. Observed with G54 and G290 in 1992. Observed with G54 and CG5-1184 in 2015 and in 2016. Observed with CG5-1184 in 2019.

MagAA, Maglarp AA, Class B. Observed with A10-020 in 2012. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2016.

Malaa, Malå, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2016.

Malun, Malung, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 1996. Observed with G54 and CG5-1184 in 2016.

Mal1p, Malung 1p, Class C. Previously used as an RG 62 point, nowadays a spare point to Malung. Observed with G54 and CG5-1184 in 2016.

MarAA, Mårtsbo AA, Class A, see Subsection 2.3.1. Previously used as an RG 82 Zero Order Network main point. Observed with G54 and G290 in 1980, in 1981, in 1982, in 1984, in 1990, in 2001, in 2002 and in 2004. Observed with G54 and CG5-1184 in 2015, in 2016 and in 2017.

MarAB, Mårtsbo AB, Class A, see Subsection 2.3.1. Observed with CG5-740 in 2012. Observed with CG5-1184 in 2017.

MartB, Mårtsbo B, Class C. Previously used as an RG 82 Zero Order Network spare point, nowadays still a spare point to Mårtsbo AA. Observed with G54 and G290 in 1975, in 1977, in 1980 and in 1984. Observed with CG5-740 in 2012. Observed with CG5-1184 in 2017.

MisAA, Misterhult AA, Class B. Previously used as an RG 82 First Order Network point. Observed with A10-020 in 2012. Observed with G54 and G290 in 2002. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2016 and in 2017.

Mon1p, Mönsterås 1p, Class C. Previously used as an RG 62 point, nowadays a spare point to Blomstermåla. Observed with CG5-1184 in 2016.

Moraa, Mora, Class, but destroyed. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2001.

MstAA, Mariestad AA, Class B. Previously used as an RG 82 First Order Network point. Observed with A10-020 in 2012. Observed with G54 and G290 in 2002. Observed with G54 and CG5-740 in 2011. Observed with CG5-740 in 2012.

MunAA, Munkfors AA, Class B. Previously used as an RG 82 First Order Network point. Observed with A10-020 in 2015. Observed with G54 and G290 in 1985.

NNy1p, Norra Ny 1p, Class C. Previously used as an RG 62 point, nowadays a spare point to Stöllet AA. Observed with G54 and G290 in 1996.

NorAA, Norrköping AA, Class B. Previously used as an RG 82 First Order Network point. Observed with A10-020 in 2012. Observed with G54 and G290 in 2002. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2016 and in 2017.

Norrt, Norrtälje, Class C. Previously used as an RG 82 First Order Network point, nowadays a spare point to Norrtälje AA. Observed with G54 and G290 in 2001. Observed with G54 and CG5-1184 in 2016.

Norsj, Norsjö, Class C. Previously used as an RG 82 First Order Network point, nowadays a spare point to Norsjö AA. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2015.

NRa1p, Norra Råda 1p, Class C. Previously used as an RG 62 point. Observed with G54 and G290 in 1996.

NsjAA, Norsjö AA, Class B. Observed with A10-020 in 2013. Observed with CG5-740 in 2013. Observed with G54 and CG5-1184 in 2015 and in 2016.

NtjAA, Norrtälje AA, Class B. Observed with A10-020 in 2015. Observed with G54 and CG5-1184 in 2015 and in 2016.

NykAA, Nyköping AA, Class B. Previously used as an RG 82 First Order Network point. Observed with A10-020 in 2011. Observed with G54 and G290 in 2002. Observed with CG5-740 in 2011.

OdeNA, Ödeshög NA, Class C. Previously used as an RG 82 Zero Order Network main point, nowadays a spare point to Västra Tollstad AA. Observed with G54 and G290 in 1981, in 1982, in 1984 and in 2002. Observed with G54 and CG5-1184 in 2016.

OdeNB, Ödeshög NB, Class C. Previously used as an RG 82 Zero Order Network spare point, nowadays a spare point to Västra Tollstad AA. Observed with G54 and G290 in 1984.

Oeroe, Ör, Class C. Previously used as an RG 82 First Order Network point, nowadays a spare point to Öjaby AA. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2016.

OjaAA, Öjaby AA, Class B. Observed with A10-020 in 2012. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2016 and in 2017.

OnsAA, Onsala AA, Class A, see Subsection 2.3.2. Observed with G54 and CG5-740 in 2013. Observed with CG5-1184 in 2019.

OnsAC, Onsala AC, Class A, see Subsection 2.3.2.

OnsAN, Onsala AN, Class A, see Subsection 2.3.2.

OnsAS, Onsala AS, Class A, see Subsection 2.3.2.

OreAA, Öregrund AA, Class B. Observed with A10-020 in 2012. Observed with G54 and CG5-1184 in 2015 and in 2017.

Orebr, Örebro, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 1990. Observed with G54 and CG5-1184 in 2016.

Ore1p, Örebro 1p, Class C. Previously used as an RG 62 point, nowadays a spare point to Örebro. Observed with G54 and G290 in 1990.

OrnAA, Örnsköldsvik AA, Class B. Observed with A10-020 in 2012. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2015. Observed with CG5-1184 in 2019.

Osbyy, Osby, Class C, but the benchmark is bent. Previously used as an RG 82 First Order Network point, nowadays a spare point to Älmhult AA. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2016.

OstAA, Östersund AA, Class A, see Subsection 3.3.6. Observed with G54 and G290 in 2004. Observed with CG5-198 in 2008. Observed with G54 and CG5-1184 in 2015 and in 2016.

OstAB, Östersund AB, Class B. Previously used as an RG 62 point. Observed with A10-020 in 2012. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2015.

OsthA, Östhammar A, Class C. Previously used as a main point along the 61st degree land uplift gravity line and an RG 82 Zero Order Network main point. Observed with several LCR instruments in 1976 and in 1983. Observed with G54 and G290 in 1981 and in 1982. Observed with G54 and G290 in 2001. Observed with G54 and CG5-1184 in 2015, in 2016 and in 2017.

OsthB, Östhammar B, Class C. Previously used as an RG 82 Zero Order Network spare point, nowadays still a spare point to Östhammar A. Observed with several LCR instruments in 1976.

OveAA, Övertorneå AA, Class B. Previously used as an RG 82 First Order Network point. Observed with A10-020 in 2013. Observed with G54 and G290 in 2002. Observed with CG5-740 in 2013. Observed with G54 and CG5-1184 in 2016.

Ove1p, Övertorneå 1p, Class C. Previously used as an RG 62 point, nowadays a spare point to Övertorneå AA. Observed with CG5-1184 in 2016.

Pajal, Pajala, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2015.

Paj1p, Pajala 1p, Class C. Previously used as an RG 62 point, nowadays a spare point to Pajala. Observed with G54 and CG5-1184 in 2015.

PelNA, Pello NA, Class C. Previously used as an RG 82 Zero Order Network main point. Observed with G54 and G290 in 1981 and in 1982. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2016.

PelNB, Pello NB, Class C. Previously used as an RG 82 Zero Order Network spare point, nowadays still a spare point to Pello NA. Observed with G54 and G290 in 1981 and in 1982.

Pel1p, Pello 1p, Class C. Previously used in RG 62, nowadays a spare point to Pello NA. Observed with G54 and G290 in 1981 and in 1982.

Porju, Porjus, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2001.

RagAA, Ragunda AA, Class B. Previously used as an RG 62 point. Observed with A10-020 in 2012. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2015.

Ramse, Ramsele, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002.

RatAA, Ratan AA, Class A, see Subsection 3.3.11. Observed with CG5-1184 in 2017 and in 2019.

RataD, Ratan B, Class C. Spare point to Ratan AA. Observed with CG5-1184 in 2017 and in 2019.

Ratby, Rätansbyn, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2001. Observed with G54 and CG5-1184 in 2017.

Rattv, Rättvik, Class C, but destroyed. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2001.

RimAA, Rimforsa AA, Class B. Observed with A10-020 in 2015. Observed with G54 and CG5-1184 in 2015, in 2016 and in 2017.

SafAA, Säffle AA, Class B, half destroyed. Previously used as an RG 82 First Order Network point. Observed with A10-020 in 2011. Observed with G54 and G290 in 1985. Observed with CG5-740 in 2011. Observed with CG5-1184 in 2017.

SarAA, Särna AA, Class B. Observed with A10-020 in 2013. Observed with CG5-740 in 2014. Observed with G54 and CG5-1184 in 2016 and in 2017.

Sarna, Särna, Class C. Previously used as an RG 82 First Order Network point, nowadays a spare point to Särna AA. Observed with G54 and G290 in 2001.

Sar1p, Särna 1p, Class C. Previously used as an RG 62 point, nowadays a spare point to Särna AA. Observed with CG5-1184 in 2016.

SavAA, Sävar AA, Class B. Previously used as a main point along the 65th degree land uplift gravity line and an RG 82 Zero Order Network main point with the name Sävar A. Observed with A10-020 in 2012. Observed with several LCR instruments in 1975 and in 1980. Observed with G54 and G290 in 1981 and in

1982. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2015. Observed with CG5-1184 in 2019.

SavaB, Sävar B, Class C. Previously used as an RG 82 Zero Order Network spare point, nowadays a spare point to Sävar AA. Observed with several LCR instruments in 1975 and in 1980.

Savsj, Sävsjö, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2016 and in 2017.

Saxna, Saxnäs, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 1992. Observed with CG5-198 and CG5-740 in 2014. Observed with G54 and CG5-1184 in 2015. Observed with G54, CG5-198 and CG5-1184 in 2019.

SFa1p, Södra Fågelås 1p, Class C. Previously used as an RG 62 point. Observed with G54 and CG5-1184 in 2016.

SimAA, Simrishamn AA, Class B. Previously used as an RG 82 First Order Network point. Observed with A10-020 in 2012. Observed with G54 and G290 in 2002. Observed with CG5-740 in 2012.

SkeAA, Skellefteå AA, Class A, see Subsection 3.3.3. Observed with G54 and G290 in 2004. Observed with G54 and CG5-1184 in 2016. Observed with CG5-1184 in 2017.

SkelF, Skellefteå B, Class C. Spare point to Skellefteå AA. Observed with CG5-1184 in 2017.

Sko1p, Skönberga 1p, Class C. Previously used as an RG 62 point, nowadays a spare point to Norrköping AA. Observed with G54 and CG5-1184 in 2016.

Sku1p, Skutskär 1p, Class C. Previously used as an RG 62 point, nowadays a spare point to LMV AA. Observed with G54 and CG5-1184 in 2015 and in 2017.

SlfAA, Sollefteå AA, Class B. Previously used as an RG 62 point. Observed with A10-020 in 2013. Observed with CG5-740 in 2013. Observed with G54 and CG5-1184 in 2015.

SlvAA, Sölvesborg AA, Class B. Observed with A10-019 in 2012. Observed with G290, CG5-740 and two Danish CG5s in 2012.

SmoAA, Smögen AA, Class A, see Subsection 2.3.9. Observed with G54 and CG5-1184 in 2017.

SodNA, Södertälje NA, Class C. Previously used as an RG 82 Zero Order Network main point. Observed with G54 and G290 in 1981, in 1982, in 1984, in 1990 and in 2002. Observed with G54 and CG5-1184 in 2016.

SodNB, Södertälje NB, Class C. Previously used as an RG 82 Zero Order Network spare point, nowadays still a spare point to Södertälje NA. Observed with G54 and G290 in 1984.

Sod1p, Söderhamn 1p, Class C. Previously used as an RG 62 point. Observed with G54 and CG5-1184 in 2016.

SolAA, Solna AA, Class B. Observed with A10-020 in 2015. Observed with G54 and CG5-1184 in 2015.

Solle, Sollefteå, Class C. Previously used as an RG 82 First Order Network point, nowadays a spare point to Sollefteå AA. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2015.

Solna, Solna, Class C. Previously used as an RG 82 First Order Network point, nowadays a spare point to Solna AA. Observed with G54 and G290 in 1990. Observed with G54 and CG5-1184 in 2015.

SolvA, Sölvesborg A, Class C. Previously used as a main point along the 56th degree land uplift gravity line and an RG 82 Zero Order Network main point, nowadays a spare point to Sölvesborg AA. Observed with several LCR instruments in 1975 and in 1980. Observed with G54 and G290 in 1981 and in 1982. Observed with G54 and G290 in 2002. Observed with G54 and G378 in 2003. Observed with G290, CG5-740 and 2 Danish CG5s in 2012.

SolvB, Sölvesborg B, Class C. Previously used as an RG 82 Zero Order Network spare point, nowadays a spare point to Sölvesborg AA. Observed with several LCR instruments in 1975.

Soppe, Soppero, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2016.

SorAA, Sorsele AA, Class B. Observed with A10-020 in 2013. Observed with CG5-740 in 2013. Observed with G54 and CG5-1184 in 2015.

Sorse, Sorsele, Class C. Previously used as an RG 82 First Order Network point, nowadays a spare point to Sorsele AA. Observed with G54 and G290 in 2001.

Stavr, Stavre, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002.

Stavv, Stavreviken, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2015.

Stb1p, Stenbrohult 1p, Class C. Previously used as an RG 62 point, nowadays a spare point to Älmhult AA. Observed with G54 and CG5-1184 in 2016.

Steke, Stekenjokk, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 1992. Observed with CG5-740 in 2012. Observed with G54, CG5-198, CG5-740 and CG5-1184 in 2019.

SteAA, Stensele AA, Class B. Observed with A10-020 in 2012. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2015 and in 2016.

StenA, Stensele A, Class C. Previously used as a main point along the 65th degree land uplift gravity line and an RG 82 Zero Order Network main point, nowadays a spare point to Stensele AA. Observed with several LCR instruments in 1975 and in 1980. Observed with G54 and G290 in 1981 and in 1982. Observed with G54 and G290 in 1992.

StenB, Stensele B, Class C. Previously used as an RG 82 Zero Order Network spare point, nowadays a spare point to Stensele AA. Observed with several LCR instruments in 1975 and in 1980. Observed with G54 and G290 in 2001. Observed with G54 and CG5-1184 in 2015.

Stk1p, Stensele B 1p, Class C. Previously used as a spare point to the RG 62 point Stensele A 1p, nowadays a spare point to Stensele AA. Observed with G54 and G290 in 1975.

StoAA, Stöllet AA, Class B. Previously used as an RG 82 First Order Network point. Observed with A10-020 in 2011. Observed with G54 and G290 in 1996. Observed with CG5-740 in 2011. Observed with G54 and CG5-1184 in 2016.

Strom, Strömsund, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2001. Observed with G54 and CG5-1184 in 2016.

Str1p, Ström 1p, Class C. Previously used as an RG 62 point, nowadays a spare point to Hallviken.

StT1p, Stora Tuna 1p, Class C. Previously used as an RG 62 point, nowadays a spare point to Borlänge. Observed with G54 and CG5-1184 in 2017.

StuAA, Stugun AA, Class B. Previously used as an RG 62 point. Observed with A10-020 in 2012. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2015.

StugA, Stugun A, Class C. Previously used as an RG 82 Zero Order Network spare point, nowadays a spare point to Stugun AA. Observed with several LCR instruments in 1972 and in 1977. Observed with G54 and G290 in 2001 and in 2002. Observed with G54 and CG5-1184 in 2015.

StugB, Stugun B, Class C. Previously used as a main point along the 63rd degree land uplift gravity line and an RG 82 Zero Order Network main point, nowadays a spare point to Stugun AA. Observed with several LCR instruments in 1972-2003. Observed with G54 and G290 in 1981 and in 1982.

StugC, Stugun C, Class C. Previously used as an RG 82 Zero Order Network spare point, nowadays a spare point to Stugun AA. Observed with several LCR instruments in 1972.

StugD, Stugun D, Class C. Previously used as an RG 82 Zero Order Network spare point, nowadays a spare point to Stugun AA. Observed with several LCR instruments in 1972.

SunAA, Sundsvall AA, Class B. Observed with A10-020 in 2012. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2015 and in 2016.

Sun1p, Sundsvall 1p, Class C. Previously used as an RG 62 point, nowadays a spare point to Sundsvall AA. Observed with CG5-1184 in 2016.

SvdAA, Sved AA, Class B. Previously used as an RG 82 First Order Network point. Observed with A10-020 in 2012. Observed with G54 and G290 in 1992. Observed with CG5-740 in 2012.

Svegg, Sveg, Class C. Previously used as an RG 82 First Order Network point, nowadays a spare point to Sveg AA. Observed with G54 and G290 in 2001. Observed with G54 and CG5-1184 in 2016 and in 2017.

Svenl, Svenljunga, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2016 and in 2017.

SvgAA, Sveg AA, Class B. Observed with A10-020 in 2013. Observed with CG5-740 in 2014. Observed with G54 and CG5-1184 in 2016 and in 2017.

SviAA, Svinnegarn AA, Class B. Observed with A10-020 in 2012. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2016 and in 2017.

SvnAA, Svenstavik AA, Class B. Previously used as an RG 82 First Order Network point. Observed with A10-020 in 2012. Observed with G54 and G290 in 2001. Observed with CG5-740 in 2012.

Syssl, Sysslebäck, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 1996.

TanAA, Tanum AA, Class B. Observed with A10-020 in 2012. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2015.

Tanna, Tännäs, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2001. Observed with G54 and CG5-1184 in 2017.

Tanum, Tanum, Class C. Previously used as an RG 82 First Order Network point, nowadays a spare point to Tanum AA. Observed with G54 and G290 in 1985.

TarAA, Tärendö AA, Class B. Observed with A10-020 in 2013. Observed with CG5-740 in 2013. Observed with G54 and CG5-1184 in 2015 and in 2016.

Tarna, Tärnaby, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2001. Observed with G54 and CG5-1184 in 2015 and in 2016.

Tarns, Tärnsjö, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2001. Observed with G54 and CG5-1184 in 2016 and in 2017.

Tin1p, Tingstäde 1p, Class C. Previously used as an RG 82 First Order Network point, nowadays a spare point to Bunge. Observed with G54 and G290 in 1984.

Torne, Torneträsk, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2001. Observed with G54 and CG5-1184 in 2016.

Torps, Torpshammar, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2015 and in 2016.

Torsa, Torsås, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2016.

Torsb, Torsby, Class C, but destroyed. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 1985.

Torup, Torup, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2016.

TraAA, Transtrand AA, Class B. Observed with A10-020 in 2012 and in 2015. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2015 and in 2017.

Trans, Transtrand, Class C. Previously used as an RG 82 First Order Network point, nowadays a spare point to Transtrand AA. Observed with G54 and G290 in 1996. Observed with G54 and CG5-1184 in 2015 and in 2017.

TulAA, Tullinge AA, Class B. Observed with A10-020 in 2011 and in 2015. Observed with G54 and CG5-1184 in 2016 and in 2017.

Uddev, Uddevalla, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 1985. Observed with G54 and CG5-1184 in 2017.

UlrAA, Ulricehamn AA, Class B. Previously used as an RG 62 point. Observed with A10-020 in 2012. Observed with CG5-740 in 2012 and in 2014. Observed with G54 and CG5-1184 in 2016.

UmbAA, Umbukta AA, Class B. Previously used as an RG 62 point. Observed with A10-020 in 2012. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2015 and in 2016.

UmbuA, Umbukta A, Class C. Previously used as a main point along the 61st degree land uplift gravity line and an RG 82 Zero Order Network main point, nowadays a spare point to Umbukta AA. Observed with several LCR instruments in 1975 and in 1980. Observed with G54 and G290 in 2001. Observed with G54 and CG5-1184 in 2015.

UmbuB, Umbukta B, Class C. Previously used as an RG 82 Zero Order Network spare point, nowadays a spare point to Umbukta AA. Observed with several LCR instruments in 1975 and in 1980.

UpC1p, Uppsala C 1p, Class C. Previously used as an RG 62 point, nowadays a spare point to Uppsala. Observed with CG5-1184 in 2016.

Uppsa, Uppsala, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2001. Observed with G54 and CG5-1184 in 2016 and in 2017.

Urshu, Urshult, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002.

ValAA, Valla AA, Class B. Previously used as an RG 82 First Order Network point. Observed with A10-020 in 2011. Observed with G54 and G290 in 2002. Observed with CG5-740 in 2011. Observed with G54 and CG5-1184 in 2016.

Vallv, Vallvik, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2016 and in 2017.

VarAA, Vara AA, Class B. Previously used as an RG 82 First Order Network point. Observed with A10-020 in 2012. Observed with G54 and G290 in 2002. Observed with G54 and CG5-740 in 2011. Observed with CG5-740 in 2012.

Var1p, Varberg Appelviksåsen A 1p, Class C. Previously used as an RG 62 point. Observed with G54 and CG5-740 in 2013.

VasNA, Västervik NA, Class C. Previously used as an RG 82 Zero Order Network main point. Observed with G54 and G290 in 1981, in 1982, in 1984 and in 2002. Observed with G54 and CG5-1184 in 2016.

VasNB, Västervik NB, Class C. Previously used as an RG 82 Zero Order Network spare point, nowadays still a spare point to Västervik NA. Observed with G54 and G290 in 1984.

Veddi, Veddige, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2002. Observed with G54 and CG5-740 in 2013. Observed with G54 and CG5-1184 in 2015.

VeiAA, Veinge AA, Class B. Observed with A10-020 in 2012. Observed with CG5-740 in 2012. Observed with G54 and CG5-740 in 2013. Observed with G54 and CG5-1184 in 2016 and in 2017.

VilAA, Vilhelmina AA, Class B. Previously used as an RG 62 point. Observed with A10-020 in 2012. Observed with G54 and G290 in 1992. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2016. Observed with CG5-198 and CG5-1184 in 2019.

Vilhe, Vilhelmina, Class C. Previously used as an RG 82 First Order Network point, nowadays a spare point to Vilhelmina AA. Observed with G54 and G290 in 1992.

Vinli, Vinliden, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 1992.

VirAA, Virserum AA, Class B. Observed with A10-020 in 2015. Observed with G54 and CG5-1184 in 2015 and in 2017.

VisAA, Visby AA, Class A, see Subsection 3.3.8. Observed with G54 in 2004.Observed with G54 and CG5-1184 in 2016 and in 2017.

VisbD, Visby D, Class C. Observed with CG5-1184 in 2017. Spare point to Visby AA.

VisNA, Visby NA, Class C. Previously used as an RG 82 Zero Order Network main point, nowadays a spare point to Visby AA. Observed with G54 and G290 in 1981 and in 1982. Observed with G54 and G290 in 1984. Observed with G54 in 2004. Observed with G54 and CG5-1184 in 2016 and in 2017.

VisNB, Visby NB, Class C. Previously used as an RG 82 Zero Order Network spare point, nowadays a spare point to Visby AA. Observed with G54 and G290 in 1984.

Vitta, Vittangi, Class C. Previously used as an RG 82 First Order Network point. Observed with G54 and G290 in 2001. Observed with G54 and CG5-1184 in 2016.

Voxna, Voxna, Class C. Previously used as an RG 82 First Order Network point, nowadays a spare point to Voxna AA. Observed with G54 and G290 in 2002. Observed with G54 and CG5-1184 in 2015 and in 2017.

VoxAA, Voxna AA, Class C. Observed with A10-020 in 2015. Observed with G54 and CG5-1184 in 2015 and in 2017.

VToAA, Västra Tollstad AA, Class B. Observed with A10-020 in 2012. Observed with CG5-740 in 2012. Observed with G54 and CG5-1184 in 2016.

The following points were added in the new realization of RG 2000, calculated in 2019:

Bur1p, Bureå 1p, Class C. Previously used as an RG 62 point, nowadays a spare point to Bureå AA. Observed with CG5-1184 in 2019.

Gra1p, Granberget 1p, Class C, but destroyed. Previously used as an RG 62 point. Observed with G54 and G290 in 1992.

Ham1p, Hamrånge 1p, Class C. Previously used as an RG 62 point. Observed with CG5-1184 in 2019.

LMute, Lantmäteriet Pol 7, Class C. Spare point to LMV AA. Observed with CG5-198 and CG5-1184 in 2019.

LyckC, Lycksele C, Class C. Previously mentioned in *Haller, Ekman (1988)* as an RG 82 Zero Order Network point spare point, without a g value, nowadays a spare point to Lycksele AA. Observed with G54 and G290 in 1988 and with CG5-1184 in 2019.

LyckD, Lycksele D, Class C. Spare point to Lycksele AA. Observed with CG5-1184 in 2019.

Nys1p, Nysätra 1p, Class C. Previously used as an RG 62 point. Observed with CG5-1184 in 2019.

OnsaA, Onsala A, Class C. Spare point to Onsala AA. Observed with CG5-1184 in 2019.

OnsaB, Onsala B, Class C. Spare point to Onsala AA. Observed with CG5-1184 in 2019.

Orn1p, Örnsköldsvik 1p, Class C. Previously used as an RG 62 point, nowadays a spare point to Örnsköldsvik AA. Observed with CG5-1184 in 2019.

OsteD, Östersund B, Class C. Spare point to Östersund AA. Observed with CG5-198 in 2008.

Vit1p, Vittangi 1p, Class C. Previously used as an RG 62 point, nowadays a spare point to Vittangi. Observed with CG5-1184 in 2016.

Vit2p, Vittangi 2p, Class C. Spare point to Vittangi. Observed with CG5-1184 in 2016.

Vss1p, Vassijaure 1p, Class C. Previously used as an RG 62 point. Observed with CG5-740 in 2014.

HelsR, Helsingør Relative, Class C. Situated in Denmark and the only Class A-C point not situated in Sweden. Previously used as a main point along the 56th degree land uplift gravity line. Observed with G54 and G378 in 2003. It has here only been used as a support to get more accurate drift sequences for the observations in 2003 along the 56th land uplift gravity lines.

Appendix 2, Tables

Here are several tables presented.

Table 23: *Relative observations included in the main adjustment of RG 2000. A: Date. B: Sequence, using the short names (see Appendix 1). C: Observer (explanation, see Table 26). D: Instrument. E: If a new drift parameter started with this sequence (Y). * The observations were just included in the 2019 realization. ** The observations were just included in the 2018 realization.*

A	B	C	D	E
2008-09-15*	OsteD-FollB-Kroko-Jarpe-OsteD	1	CG5_198	Y
2008-09-16*	OstAA-OsteD-OstAA-OsteD-OsteD-OstAA-OsteD-OstAA-OsteD-OstAA	1	CG5_198	
2008-09-19	KraAA-KraAB-KraAB-KraAA	1	CG5_198	Y
2008-09-19	KraAA-KraAB-KraAB-KraAA	1	CG5_198	
2011-04-27	MstAA-VarAA-VarAA-MstAA	1	CG5_740	Y
2011-09-14	NykAA-ValAA-ArbAA	1	CG5_740	Y
2011-09-15	LjuAA-SafAA-AarAA-KarAA	1	CG5_740	
2011-09-16	FryAA-StoAA-VanAA	1	CG5_740	
2012-03-14	MartB-MarAB-MarAB-MartB	1	CG5_740	Y
2012-04-16	SlvAA-SolvA-SlvAA	1	CG5_740	Y
2012-04-16	SlvAA-SolvA-SlvAA	1	CG5_740	
2012-04-17	HooAA-HoorB-HooAA	1	CG5_740	
2012-04-17	HooAA-HoorB-HooAA	1	CG5_740	
2012-07-23	AlvAA-TraAA	1	CG5_740	Y
2012-07-24	HedAA-OtuAA-SvnAA-OstAB	1	CG5_740	
2012-07-25	DuvAA-StuAA-RagAA-HamAA	1	CG5_740	
2012-07-26	SvdAA-Steke-KliAA	1	CG5_740	
2012-07-27	SteAA-VilAA-AseAA-Gulse-KraAB	1	CG5_740	
2012-07-28	SunAA-BBrAA	1	CG5_740	
2012-08-07	RatAA-HolAA-RatAA	1	CG5_740	
2012-08-08	RatAA-SavAA-RatAA-HonAA-RatAA	1	CG5_740	
2012-09-30	LaxAA-MstAA-VarAA-TanAA	1	CG5_740	
2012-10-01	GriAA-UlrAA-KrdAA-OjaAA	1	CG5_740	
2012-10-02	AlmAA-VeiAA-HelAA-MagAA	1	CG5_740	
2012-10-03	SimAA-AugAA	1	CG5_740	

2012-10-04	EmmAA-KopAA-LjbAA-MisAA	1	CG5_740	
2012-10-05	GamAA-EksAAA-VToAA-LjfAA	1	CG5_740	
2012-10-08	OreAA-OsthA-OsthA-OreAA	1	CG5_740	
2012-10-16	LMVAA-BolAA-BolAA-LMVAA	1	CG5_740	Y
2013-04-20	BorAA-Boras-Bor1p-BorAA	1	CG5_740	Y
2013-04-21	BorAA-Bor1p-Boras-BorAA	1	CG5_740	
2013-05-01	OnsAA-GotNB-GotNB-OnsAA	1	CG5_740	Y
2013-05-01	GotNB-GriAA-GriAA-GotNB	1	CG5_740	
2013-05-02	OnsAA-Veddi-Var1p-Var1p-OnsAA	1	CG5_740	
2013-05-02	Var1p-VeiAA-VeiAA-Var1p	1	CG5_740	
2013-05-03	OnsAA-Var1p-Veddi-OnsAA	1	CG5_740	Y
2013-05-08*	LMVAA-HusAA-BBrAA-LMVAA	1	CG5_740	
2013-08-30	NsjAA-SorAA-ArvAA	1	CG5_740	Y
2013-08-31	KabAA-GalAA	1	CG5_740	
2013-09-01	KsuAA-TarAA	1	CG5_740	
2013-09-02	OveAA-HunAA-LulAA	1	CG5_740	
2014-04-29	LjdAA-SvgAA-SarAA	1	CG5_740	Y
2014-04-30	LekAA-FreAA-GryAA	1	CG5_740	
2014-06-06	BorAA-Boras-Boras-BorAA	1	CG5_740	Y
2014-06-07	BorAA-UlrAA-UlrAA-BorAA	1	CG5_740	Y
2014-06-27	Saxna-KliAA-KliAA-Saxna	13	CG5_198	Y
2014-06-27	Saxna-KliAA-KliAA-Saxna	1	CG5_740	Y
2014-07-15*	BjoNB-Vss1p-BjoNB	1	CG5_740	
2014-09-16*	LMVAA-HusAA-LMVAA	1	CG5_740	Y
2015-06-16	Sku1p-MarAA-MarAA-Sku1p	1	CG5_1184	Y
2015-06-17	OsthA-NtjAA-NtjAA-OsthA	1	CG5_1184	
2015-06-18	OreAA-OsthA-OsthA-OreAA	1	CG5_1184	
2015-06-22	Torps-BrgAA-BrgAA-Torps	1	CG5_1184	Y
2015-06-23	StugA-StuAA-StuAA-StugA	1	CG5_1184	
2015-06-23	RagAA-StugA-StugA-RagAA	1	CG5_1184	
2015-06-23	RagAA-Solle	1	CG5_1184	
2015-06-23	Solle-SlfAA-SlfAA-Solle	1	CG5_1184	
2015-06-24	JunAA-Gulse-AseAA	1	CG5_1184	

2015-06-24	AseAA-Saxna	1	CG5_1184	
2015-06-24	Saxna-KliAA-KliAA-Saxna	1	CG5_1184	
2015-06-25	Tarna-UmbAA-UmbAA-Tarna	1	CG5_1184	
2015-06-25	UmbAA-UmbuA-UmbuA-UmbAA	1	CG5_1184	
2015-06-26	StenB-SorAA-SorAA-StenB	1	CG5_1184	
2015-06-26	StenB-SteAA-SteAA-StenB	1	CG5_1184	
2015-06-27	AseAA-Gulse-JunAA	1	CG5_1184	
2015-06-27	JunAA-Stavv	1	CG5_1184	
2015-06-27	Stavv-SunAA-SunAA-Stavv	1	CG5_1184	
2015-08-03	BolAA-Arbra-Arbra-BolAA	1	CG5_1184	Y
2015-08-03	BolAA-VoxAA	1	CG5_1184	
2015-08-03	VoxAA-Voxna-Voxna-VoxAA	1	CG5_1184	
2015-08-04	TraAA-Trans-Trans-TraAA	1	CG5_1184	
2015-08-04	TraAA-AlvAA	1	CG5_1184	
2015-08-04	AlvAA-AlvdA-AlvdA-AlvAA	1	CG5_1184	
2015-08-06	GryAA-Avest-Avest-GryAA	1	CG5_1184	
2015-08-06	GryAA-LekAA	1	CG5_1184	
2015-08-06	LekAA-Borla-Borla-LekAA	1	CG5_1184	
2015-08-10	HarAA-KraAB-OrnAA	1	CG5_1184	Y
2015-08-11	Alvsb-AlbAA-AlbAA-Alvsb	1	CG5_1184	
2015-08-11	AlbAA-Bergn	1	CG5_1184	
2015-08-11	Bergn-LulAA-LulAA-Bergn	1	CG5_1184	
2015-08-13	Hapar-HapAA-HapAA-Hapar	1	CG5_1184	
2015-08-13	HapAA-OveAA	1	CG5_1184	
2015-08-14	Pajal-TarAA-TarAA-Pajal	1	CG5_1184	
2015-08-14	Paj1p-Pajal-Pajal-Paj1p	1	CG5_1184	
2015-08-14	Paj1p-KsuAA	1	CG5_1184	
2015-08-14	KsuAA-Kares-Kares-KsuAA	1	CG5_1184	
2015-08-15	Galli-GalAA-GalAA-Galli	1	CG5_1184	
2015-08-15	Galli-Jok1p	1	CG5_1184	
2015-08-15	Jok1p-Jokkm-Jokkm-Jok1p	1	CG5_1184	
2015-08-15	Jok1p-Arvid	1	CG5_1184	
2015-08-15	Arvid-ArvAA-ArvAA-Arvid	1	CG5_1184	

2015-08-15	ArvAA-Arv1p-Arv1p-ArvAA	1	CG5_1184	
2015-08-16	Norsj-NsjAA-NsjAA-Norsj	1	CG5_1184	
2015-08-17	OrnAA-KraAB-HarAA	1	CG5_1184	
2015-09-01	RatAA-SavAA-SavAA-RatAA	1	CG5_1184	Y
2015-09-01	RatAA-HonAA	1	CG5_1184	
2015-09-01	HonAA-Hon1p-Hon1p-HonAA	1	CG5_1184	
2015-09-02	RatAA-HolAA-HolAA-RatAA	1	CG5_1184	
2015-09-04	KirAA-JukNA-JukNA-KirAA	1	CG5_1184	
2015-09-19	LycAA-LyckA-LyckA-LycAA	1	CG5_1184	Y
2015-09-21	OstAA-HamAA-HamAA-OstAA	1	CG5_1184	
2015-09-22	OstAA-OstAB-OstAB-OstAA	1	CG5_1184	
2015-10-05	SolAA-Solna-Solna-SolAA	1	CG5_1184	Y
2015-10-05	SolAA-RimAA	1	CG5_1184	
2015-10-05	RimAA-Kisaa-Kisaa-RimAA	1	CG5_1184	
2015-10-06	RimAA-VirAA	1	CG5_1184	Y
2015-10-06	Aseda-VirAA-VirAA-Aseda	1	CG5_1184	
2015-10-06	Aseda-FalAA	1	CG5_1184	
2015-10-07	FalAA-Veddi-Veddi-FalAA	1	CG5_1184	
2015-10-07	FalAA-BalAA	1	CG5_1184	
2015-10-07	BalAA-Dalaa-Dalaa-BalAA	1	CG5_1184	
2015-10-08	KloAA-DalsE-TanAA-TanAA-DalsE-KloAA	1	CG5_1184	
2015-10-14*	LMVAA-HusAA-LMVAA	1	CG5_1184	
2015-10-14*	LMVAA-HusAA-LMVAA	1	CG5_740	Y
2016-03-30*	LMVAA-HusAA-HusAA-LMVAA	1	CG5_1184	Y
2016-04-05	SviAA-Halls-Halls-SviAA	1	CG5_1184	Y
2016-04-05	Halls-ArbAA-ArbAA-Halls	1	CG5_1184	
2016-04-11	Sko1p-NorAA-OdeNA-OdeNA-NorAA-Sko1p	1	CG5_1184	Y
2016-04-11	OdeNA-VToAA-VToAA-OdeNA	1	CG5_1184	
2016-04-12	RimAA-Kisaa-Kisaa-RimAA	1	CG5_1184	
2016-04-12	Kisaa-Lonne-EksAA-EksAA-Lonne-Kisaa	1	CG5_1184	
2016-04-12	EksAA-Savsj-Savsj-EksAA	1	CG5_1184	
2016-04-13	GamAA-VasNA-VasNA-GamAA	1	CG5_1184	
2016-04-13	GamAA-Mon1p	1	CG5_1184	

2016-04-13	Mon1p-Bloms-Bloms-Mon1p	1	CG5_1184	
2016-04-13	Bloms-MisAA-MisAA-Bloms	1	CG5_1184	
2016-04-14	LjbAA-Borgh-Borgh-LjbAA	1	CG5_1184	
2016-04-14	Borgh-KopAA-Kastl-Kastl-KopAA-Borgh	1	CG5_1184	
2016-04-14	LjbAA-Bloms-Bloms-LjbAA	1	CG5_1184	
2016-04-15	LjbAA-Dor1p-Dor1p-LjbAA	1	CG5_1184	
2016-04-15	LjbAA-EmmAA-EmmAA-LjbAA	1	CG5_1184	
2016-04-15	EmmAA-Alg1p-Alg1p-EmmAA	1	CG5_1184	
2016-04-15	EmmAA-Torsa-Torsa-EmmAA	1	CG5_1184	
2016-04-16	Johan-AugAA-Jam1p-Jam1p-AugAA-Johan	1	CG5_1184	
2016-04-16	Johan-Stb1p	1	CG5_1184	
2016-04-16	Stb1p-AlmAA-AlmAA-Stb1p-Lagan	1	CG5_1184	
2016-04-16	AlmAA-Osbyy-Osbyy-AlmAA	1	CG5_1184	
2016-04-20	LMVAA-Tarns-Uppsa-LMVAA	1	CG5_1184	Y
2016-04-21	LMVAA-Uppsa-Uppsa-Tarns-LMVAA	1	CG5_1184	
2016-04-21	Uppsa-UpC1p-UpC1p-Uppsa	1	CG5_1184	
2016-04-21	Uppsa-HusAA-HusAA-Uppsa	1	CG5_1184	
2016-04-26	Linde-LjuAA-LjuAA-Linde	1	CG5_1184	Y
2016-04-26	Linde-Orebr	1	CG5_1184	
2016-04-26	Orebr-ArbAA-ArbAA-Orebr	1	CG5_1184	
2016-04-27	KarNA-KarAA-KarAA-KarNA	1	CG5_1184	Y
2016-04-27	KarAA-Arvik-Arvik-KarAA	1	CG5_1184	
2016-04-27	Arvik-AarAA-AarAA-Arvik	1	CG5_1184	
2016-04-28	Orebr-LjfAA-LjfAA-Orebr	1	CG5_1184	Y
2016-05-04	LMVAA-BBrAA-Hyboo-Hyboo-BBrAA-LMVAA	1	CG5_1184	Y
2016-05-04	Hyboo-LjdAA-LjdAA-Hyboo	1	CG5_1184	
2016-05-06	LMVAA-Vallv-BBrAA-Gnarp-Gnarp-BBrAA-Vallv-LMVAA	1	CG5_1184	
2016-05-12	LMVAA-HofoB-GryAA-Avest-Avest-GryAA-HofoB-LMVAA	1	CG5_1184	Y
2016-05-16	TulAA-SodNA-SodNA-TulAA	1	CG5_1184	Y
2016-05-21	VisAA-VisNA-VisNA-VisAA	1	CG5_1184	Y
2016-05-31	Gnarp-SunAA-SunAA-Torps-Torps-SunAA	1	CG5_1184	Y
2016-05-31	SunAA-Sun1p-Sun1p-SunAA	1	CG5_1184	
2016-06-01	OstAA-Kroko-Jarpe-DuvAA-Aannn-Aannn-DuvAA-Jarpe-Kroko-	1	CG5_1184	

	OstAA			
2016-06-02	HamAA-Hallv-Hotin-VilAA-VilAA-Hotin-Hallv-HamAA	1	CG5_1184	
2016-06-03	SteAA-Strom-Tarna-Hemav-UmbAA-UmbAA-Hemav-Tarna-Strom-SteAA	1	CG5_1184	
2016-06-04	LyckA-LycAA-LycAA-LyckA	1	CG5_1184	
2016-06-08	LMVAA-Aamot-Aamot-LMVAA	1	CG5_1184	Y
2016-06-20	Lin1p-Linde-Linde-Lin1p	1	CG5_1184	Y
2016-06-20	Lin1p-Eksha	1	CG5_1184	
2016-06-20	Eksha-FryAA-FryAA-Eksha	1	CG5_1184	
2016-06-21	Mal1p-Malun-StoAA-StoAA-Malun-Mal1p	1	CG5_1184	
2016-06-21	Mal1p-SarAA	1	CG5_1184	
2016-06-21	SarAA-Idree-Idree-SarAA	1	CG5_1184	
2016-06-22	Svegg-SvgAA-SvgAA-Svegg	1	CG5_1184	
2016-06-22	Svegg-HedAA-Hedee-Ratby-OtuAA-OtuAA-Ratby-Hedee-HedAA-Svegg	1	CG5_1184	
2016-07-06	LMVAA-KraAA-KraAA-LMVAA	1	CG5_1184	Y
2016-08-09	LMVAA-Vallv-Vallv-LMVAA	1	CG5_1184	Y
2016-08-09	Vallv-BolAA-Sod1p-Vallv	1	CG5_1184	
2016-08-09	Vallv-Sod1p-BolAA-Vallv	1	CG5_1184	
2016-08-11	Gnarp-SunAA-SunAA-Gnarp	1	CG5_1184	Y
2016-08-12	BurAA-Burtr-SkeAA-Lidtr-Lidtr-SkeAA-Burtr-BurAA	1	CG5_1184	
2016-08-14	Kalix-HunAA-Bergn-Kalix	1	CG5_1184	
2016-08-15	GalAA-Jokkm-Jokkm-GalAA	1	CG5_1184	
2016-08-15	Lansa-Hakka-GalAA-GalAA-JukNA	1	CG5_1184	
2016-08-16	Vitta-Soppe-Soppe-Vitta	1	CG5_1184	
2016-08-16	JukNA-Vitta-Vitta-JukNA	1	CG5_1184	
2016-08-16	Vitta-Junos-Junos-Vitta	1	CG5_1184	
2016-08-16	Junos-TarAA-TarAA-Junos	1	CG5_1184	
2016-08-16*	Vitta-Vit2p-Vit1p-Vitta	1	CG5_1184	
2016-08-17	JukNA-Torne-BjoNB-BjoNB-Torne-JukNA	1	CG5_1184	
2016-08-17	JukNA-GalAA-Hakka-Lansa	1	CG5_1184	
2016-08-18	Kalix-HapAA-OveAA-Ove1p-Ove1p-OveAA-HapAA-Kalix	1	CG5_1184	
2016-08-20	Kalix-Lansa-OveAA-PelNA-PelNA-OveAA-Lansa-Kalix	1	CG5_1184	

2016-08-21	Kalix-Bergn-HunAA-Kalix	1	CG5_1184	
2016-08-22	ArvAA-Malaa-NsjAA-NsjAA-Malaa-ArvAA	1	CG5_1184	
2016-08-23	ArjAB-Arjep-Arjep-ArjAB	1	CG5_1184	Y
2016-08-23	Arjep-ArjAA-ArjAA-Arjep	1	CG5_1184	
2016-08-28	Eskil-ValAA-ValAA-Eskil	1	CG5_1184	Y
2016-08-29	SFa1p-Dalaa-BalAA-Bottn-UlrAA-UlrAA-Bottn-BalAA-Dalaa-SFa1p	1	CG5_1184	
2016-08-30	KrdAA-Lagan-OjaAA-Oeroe-Oeroe-OjaAA-Lagan-KrdAA	1	CG5_1184	Y
2016-08-30	KrdAA-Svenl-Svenl-KrdAA	1	CG5_1184	Y
2016-08-31	KrdAA-Hille-Hille-KrdAA	1	CG5_1184	Y
2016-08-31	KrdAA-Torup-FalAA-FalAA-Torup-KrdAA	1	CG5_1184	Y
2016-09-01	Astor-HelAA-Dalby-MagAA-MagAA-Dalby-HelAA-Astor	1	CG5_1184	Y
2016-09-02	Lahol-VeiAA-VeiAA-Lahol	1	CG5_1184	Y
2016-09-08	LMVAA-MarAA-OsthA-OsthA-MarAA-LMVAA	1	CG5_1184	Y
2016-09-12	LMVAA-OsthA-Norrt-Norrt-OsthA-LMVAA	1	CG5_1184	
2016-09-12	Norrt-NtjAA-NtjAA-Norrt	1	CG5_1184	
2016-09-15*	LMVAA-HusAA-HusAA-LMVAA	1	CG5_1184	Y
2016-09-28	LMVAA-LekAA-VanAA-FreAA-LjuAA-GryAA-LMVAA	1	CG5_1184	
2016-10-11	LMVAA-SviAA-SviAA-LMVAA	1	CG5_1184	Y
2016-10-11	SviAA-HusAA-HusAA-SviAA	1	CG5_1184	
2016-10-11	HusAA-NtjAA-NtjAA-HusAA	1	CG5_1184	
2017-03-23*	LMVAA-HusAA-HusAA-LMVAA	1	CG5_1184	Y
2017-03-28	VisAA-VisNA-VisNA-VisAA	1	CG5_1184	
2017-03-29	VisAA-Garde-Garde-VisAA	1	CG5_1184	
2017-03-29	VisAA-VisbD-VisAA	1	CG5_1184	
2017-03-30	VisAA-VisbD-VisAA	1	CG5_1184	
2017-04-01	BorAA-Svenl-Svenl-BorAA	1	CG5_1184	
2017-04-02	BorAA-Boras-Boras-BorAA	1	CG5_1184	
2017-04-06	NorAA-Motal-Motal-NorAA	1	CG5_1184	Y
2017-04-07	RimAA-Atvid-GamAA-GamAA-Atvid-RimAA	1	CG5_1184	
2017-04-26	LMVAA-Uppsa-SviAA-Halls-Halls-SviAA-Uppsa-LMVAA	1	CG5_1184	Y
2017-04-28	LMVAA-Vallv-Vallv-LMVAA	1	CG5_1184	
2017-05-02	LMVAA-OsthA-OsthA-LMVAA	1	CG5_1184	Y

2017-05-02	OsthA-OreAA-OreAA-OsthA	1	CG5_1184	
2017-05-04	Lud1p-LjuAA-Gryth-Gryth-LjuAA-Lud1p	1	CG5_1184	
2017-05-05	VanAA-TraAA-Trans-TraAA-SarAA-SarAA-TraAA-VanAA	1	CG5_1184	
2017-05-12	LMVAA-Tarns-GryAA-GryAA-Tarns-LMVAA	1	CG5_1184	Y
2017-05-15	Borla-StT1p-StT1p-Borla	1	CG5_1184	
2017-06-28	MarAA-UpC1p-Uppsa-Uppsa-UpC1p-MarAA	5	CG5_1184	Y
2017-08-30	LjdAA-Lafor-Ratby	1	CG5_1184	Y
2017-08-30	Ratby-Lafor-LjdAA	1	CG5_1184	
2017-08-31	BolAA-VoxAA-SvgAA	1	CG5_1184	
2017-09-01	SvgAA-VoxAA-BolAA	1	CG5_1184	
2017-08-31	SvgAA-Svegg	1	CG5_1184	Y
2017-08-31	Svegg-SvgAA	1	CG5_1184	
2017-08-31	SvgAA-Lofsd-Tanna-HedAA-Hedee-SvgAA	1	CG5_1184	
2017-09-01	SvgAA-HedAA-Tanna-Lofsd-SvgAA	1	CG5_1184	
2017-09-01	VoxAA-Voxna-VoxAA	1	CG5_1184	
2017-09-12	MarAA-MarAB-MartB-MarAA	1	CG5_1184	Y
2017-09-12	MarAA-MartB-MarAB-MarAA	1	CG5_1184	
2017-09-19	ArjeF-ArjAA-ArjAA-ArjeF	1	CG5_1184	Y
2017-09-20	ArjAB-Jakkv-Jakkv-ArjAB	1	CG5_1184	
2017-09-22	SkelF-JavNB-JavNB-SkelF	1	CG5_1184	
2017-09-22	JavNB-JavNA-JavNA-JavNB	1	CG5_1184	
2017-09-23	BurAA-Lovan-Lovan-BurAA	1	CG5_1184	Y
2017-09-23	Lovan-RatAA-RatAA-Lovan	1	CG5_1184	
2017-09-23	RatAA-RataD-RataD-RatAA	1	CG5_1184	
2017-09-23	SkeAA-SkelF-SkelF-RatAA	1	CG5_1184	
2017-09-25	Aneby-EksAA-Lonne-Lonne-EksAA-Aneby	1	CG5_1184	Y
2017-09-26	OjaAA-VirAA-Lonne-MisAA-MisAA-Lonne-VirAA-OjaAA	1	CG5_1184	
2017-09-27	OjaAA-Lagan-Lagan-OjaAA	1	CG5_1184	Y
2017-09-27	Savsj-VeiAA-Lahol-Lahol-VeiAA-Savsj	1	CG5_1184	
2017-09-28	KloAA-Uddev-SmoAA-SmoAA-Uddev-KloAA-SafAA	1	CG5_1184	
2017-10-11	LMVAA-Sku1p-Sku1p-LMVAA	1	CG5_1184	Y
2017-10-26	TulAA-Jordb-Jordb-TulAA	1	CG5_1184	Y
2019-06-04*	LMVAA-LMute-LMVAA	1	CG5_1184	Y

2019-06-09*	LycAA-LyckD-LycAA	1	CG5_1184	Y
2019-06-11*	LyckA-LyckB-LyckB-LyckA	1	CG5_1184	
2019-06-13*	BurAA-Bur1p-Bur1p-BurAA	1	CG5_1184	
2019-06-15*	RataD-SavAA-SavAA-RataD	1	CG5_1184	
2019-06-18*	RatAA-Nys1p-Nys1p-RatAA	1	CG5_1184	
2019-08-06*	OnsAA-OnslA-OnslA-OnsAA-OnslB-OnslB-OnsAA	1	CG5_1184	Y
2019-08-26*	LMVAA-Ham1p-Ham1p-LMVAA	1	CG5_1184	Y
2019-08-29*	LMVAA-LMute-LMute-LMVAA-LMVAA-LMute-LMute-LMVAA	1	CG5_1184	Y
2019-09-10*	LMVAA-HusAA-HusAA-LMVAA	1	CG5_1184	Y
2019-09-10*	LMVAA-HusAA-HusAA-LMVAA	1	CG5_198X	Y
2019-09-18*	VilAA-Saxna-KliAA-Steke-Steke-KliAA-Saxna-VilAA	1	CG5_1184	Y
2019-09-18*	VilAA-Saxna-KliAA-Steke-Steke-KliAA-Saxna-VilAA	1	CG5_198X	Y
2019-09-18*	KliAA-Steke-Steke-KliAA	1	CG5_740	Y
2019-09-27*	Ludvi-Lud1p-Ludvi	1	CG5_1184	Y
2019-09-27*	Ludvi-Lud1p-Lud1p-Ludvi	1	CG5_198X	Y
2019-10-07*	LMVAA-LMute-LMVAA-LMute-LMVAA	1	CG5_198X	Y
1975-10-02	StenA-StenB-StenA		G2900	Y
1975-10-08	UmbAA-UmbuA-UmbAA-UmbuA		G2900	
1975-10-10	Stk1p-StenA-StenB-StenA-Stk1p-StenB-StenA-StenB		G2900	
1975-11-19	MartB-Sod1p-MartB-Sod1p-MartB		G2900	Y
1975-11-21	MartB-Sku1p-MartB-Sku1p-MartB		G2900	
1975-10-02	StenA-StenB-StenA		G544	Y
1975-10-08	UmbAA-UmbuA-UmbAA-UmbuA		G544	
1975-10-10	Stk1p-StenA-StenB-StenA-Stk1p-StenB-StenA-StenB		G544	
1975-11-19	MartB-Sod1p-MartB-Sod1p-MartB		G544	Y
1975-11-21	MartB-Sku1p-MartB-Sku1p-MartB		G544	
1977-09-23	KraAB-Sun1p-MartB		G2900	Y
1977-09-07	MartB-Sun1p-KraAB		G544	Y
1977-09-23	KraAB-Sun1p-MartB		G544	
1977-09-28	MartB-Sun1p-KraAB		G544	
1977-10-14	StugB-Sun1p-MartB		G544	
1977-11-15	Kri1p-SolvA-SolvA-Kri1p		G544	Y
1977-11-16	Kri1p-SolvA-SolvA-Kri1p		G544	

1980-08-08*	MarAA-HofoA-MarAA-HofoA-MarAA	2	G290	Y
1980-09-03*	MarAA-HofoA-HofoA-MarAA	2	G290	
1980-07-18*	MarAA-MartB-MarAA-MartB-MarAA-MarAA-MartB-MarAA-MartB	2	G54	Y
1980-08-08*	MarAA-HofoA-MarAA-HofoA-MarAA	2	G54	Y
1980-08-25*	GoteA-GotNB-GoteA-GotNB-GoteA-GotNB-GoteA-GotNB	2	G54	Y
1980-09-03*	MarAA-HofoA-HofoA-MarAA	2	G54	Y
1981-05-12-13	VisNA-VasNA-VasNA-SodNA	2	G290	Y
1981-05-22	Tur1p-SodNA-Tur1p-SodNA-OsthA-OsthA-SodNA	2	G290	
1981-05-23	SodNA-OsthA-OsthA-SodNA	2	G290	
1981-05-24	SodNA-KarNA-KarNA-SodNA	2	G290	
1981-05-26	KarNA-GotNB-GotNB-KarNA	2	G290	
1981-05-27	KarNA-SodNA-SodNA-KarNA	2	G290	
1981-06-03	SodNA-Tur1p-SodNA-Tur1p	2	G290	Y
1981-06-23	MarAA-HofoA-HofoA-MarAA	3	G290	Y
1981-06-24	MarAA-KraAB-KraAB-MarAA	3	G290	
1981-06-25	MarAA-KraAB-KraAB-MarAA	3	G290	
1981-06-27	KramA-SavAA-SavAA-KramA	3	G290	
1981-06-28	KramA-SavAA-SavAA-KramA	3	G290	
1981-07-02	StenA-FollA-FollA-StenA	3	G290	
1981-07-03	StenA-FollA-FollA-StenA	3	G290	
1981-07-11	FollA-AlvdA-AlvdA-FollA	3	G290	
1981-07-12	FollA-AlvdA-AlvdA-FollA	3	G290	
1981-07-14	MarAA-OsthA-OsthA-MarAA		G290	
1981-07-15	MarAA-OsthA-OsthA-MarAA		G290	
1981-07-17-19	MarAA-OsthA-OsthA-MarAA		G290	
1981-08-12-13	VasNA-VisNA-VasNA	2	G290	Y
1981-08-14	VasNA-OdeNA-OdeNA-VasNA	2	G290	
1981-08-14-17	VasNA-VisNA-VisNA-VasNA	2	G290	
1981-08-18-19	VasNA-VisNA-VisNA-VasNA	2	G290	
1981-08-20	VasNA-SolvA-SolvA-VasNA	2	G290	
1981-05-12-13	VisNA-VasNA-VasNA-SodNA	2	G54	Y
1981-05-22	Tur1p-SodNA-Tur1p-SodNA-OsthA-OsthA-SodNA	2	G54	

1981-05-23	SodNA-OsthA-OsthA-SodNA	2	G54	
1981-05-24	SodNA-KarNA-KarNA-SodNA	2	G54	
1981-05-26	KarNA-GotNB-GotNB-KarNA	2	G54	
1981-05-27	KarNA-SodNA-SodNA-KarNA	2	G54	
1981-06-03	SodNA-Tur1p-SodNA-Tur1p	2	G54	Y
1981-06-23	MarAA-HofoA-HofoA-MarAA	3	G54	Y
1981-06-24	MarAA-KraAB-KraAB-MarAA	3	G54	
1981-06-25	MarAA-KraAB-KraAB-MarAA	3	G54	
1981-06-27	KramA-SavAA-SavAA-KramA	3	G54	
1981-06-28	KramA-SavAA-SavAA-KramA	3	G54	
1981-07-02	StenA-FollA-FollA-StenA	3	G54	
1981-07-03	StenA-FollA-FollA-StenA	3	G54	
1981-07-11	FollA-AlvdA-AlvdA-FollA	3	G54	
1981-07-12	FollA-AlvdA-AlvdA-FollA	3	G54	
1981-07-14	MarAA-OsthA-OsthA-MarAA		G54	
1981-07-15	MarAA-OsthA-OsthA-MarAA		G54	
1981-07-17-19	MarAA-OsthA-OsthA-MarAA		G54	
1981-08-12-13	VasNA-VisNA-VisNA-VasNA	2	G54	Y
1981-08-14	VasNA-OdeNA-OdeNA-VasNA	2	G54	
1981-08-14-17	VasNA-VisNA-VisNA-VasNA	2	G54	
1981-08-18-19	VasNA-VisNA-VisNA-VasNA	2	G54	
1981-08-20	VasNA-SolvA-SolvA-VasNA	2	G54	
1982-06-02	SodNA-VasNA-VasNA-SodNA	2	G290	Y
1982-06-03-04	SodNA-Tur1p-SodNA-Tur1p-SodNA-VisNA-VisNA-SodNA	2	G290	
1982-06-05-08	SodNA-VisNA-VisNA-SodNA	2	G290	
1982-06-09	VasNA-SodNA-SodNA-VasNA	2	G290	
1982-06-11	OdeNA-VasNA-VasNA-OdeNA	2	G290	
1982-06-12	OdeNA-GotNB-GotNB-OdeNA	2	G290	
1982-06-14	GotNB-OdeNA-OdeNA-GotNB	2	G290	
1982-06-15	GotNB-KarNA-KarNA-GotNB	2	G290	
1982-06-20	KarNA-AlvdA-AlvdA-KarNA	2	G290	
1982-06-23	AlvdA-KarNA-KarNA-AlvdA	2	G290	
1982-06-29	KraAB-KramA-KraAB-KramA	3	G290	Y

1982-06-30	KramA-KraAB-KramA-KraAB	3	G290	
1982-07-01	SavAA-JavNA-JavNA-SavAA	3	G290	
1982-07-03	JavNA-SavAA	3	G290	
1982-07-03	SavAA-JavNA	3	G290	
1982-07-04	JavNA-KabAA-JavNA	3	G290	
1982-07-05	JavNA-PelNA-PelNA-JavNA	3	G290	
1982-07-06	KabAA-KviNA-KviNA-KabAA	3	G290	
1982-07-07	KabAA-JukNA-JukNA-KabAA	3	G290	
1982-07-08	PelNA-PelNB-PelNA-PelNB	3	G290	
1982-07-12	PelNA-Pel1p-Pel1p-PelNA	3	G290	
1982-07-13	PelNA-JavNA-JavNA-PelNA-Pel1p	3	G290	
1982-07-14	PelNA-JukNA-PelNA-Pel1p	3	G290	
1982-07-15	PelNB-PelNA-PelNB-PelNA	3	G290	
1982-07-16	JukNA-PelNA-PelNA-JukNA	3	G290	
1982-07-17	JukNA-KabAA-KabAA-JukNA	3	G290	
1982-07-18	JukNA-BjoNA-BjoNA-JukNA	3	G290	
1982-07-22	BjoNA-JukNA-JukNA-BjoNA	3	G290	
1982-07-23	JukNA-KviNA-KviNA-JukNA	3	G290	
1982-07-24	JukNA-KiK1p-JukNA-KiK1p-KiK1p	3	G290	
1982-07-25	KabAA-Kab1p-KabAA-Kab1p	3	G290	
1982-07-26	KabAA-StenA-StenA-KabAA	3	G290	
1982-07-27	KabAA-JavNA-JavNA-KabAA	3	G290	
1982-07-28	StenA-KabAA-KabAA-StenA	3	G290	
1982-07-30	OstAB-StugB-StugB-OstAB	3	G290	
1982-07-31	OstAB-FollA-FollA-OstAB	3	G290	
1982-08-01	AlvdA-Sar1p-AlvdA	3	G290	
1982-08-04	MarAA-OsthA-OsthA-MarAA		G290	
1982-08-06	OsthA-MarAA-MarAA-OsthA		G290	
1982-06-02	SodNA-VasNA-VasNA-SodNA	2	G54	Y
1982-06-03-04	SodNA-Tur1p-SodNA-Tur1p-SodNA-VisNA-VisNA-SodNA	2	G54	
1982-06-05-08	SodNA-VisNA-VisNA-SodNA	2	G54	
1982-06-09	VasNA-SodNA-SodNA-VasNA	2	G54	
1982-06-11	OdeNA-VasNA-VasNA-OdeNA	2	G54	

1982-06-12	OdeNA-GotNB-GotNB-OdeNA	2	G54	
1982-06-14	GotNB-OdeNA-OdeNA-GotNB	2	G54	
1982-06-15	GotNB-KarNA-KarNA-GotNB	2	G54	
1982-06-20	KarNA-AlvdA-AlvdA-KarNA	2	G54	
1982-06-23	AlvdA-KarNA-KarNA-AlvdA	2	G54	
1982-06-29	KraAB-KramA-KraAB-KramA	3	G54	Y
1982-06-30	KramA-KraAB-KramA-KraAB	3	G54	
1982-07-01	SavAA-JavNA-JavNA-SavAA	3	G54	
1982-07-03	JavNA-SavAA-SavAA-JavNA	3	G54	
1982-07-04	JavNA-KabAA-KabAA-JavNA	3	G54	
1982-07-05	JavNA-PelNA-PelNA-JavNA	3	G54	
1982-07-06	KabAA-KviNA-KviNA-KabAA	3	G54	
1982-07-07	KabAA-JukNA-JukNA-KabAA	3	G54	
1982-07-08	PelNA-PelNB-PelNA-PelNB	3	G54	
1982-07-12	PelNA-Pel1p-Pel1p-PelNA	3	G54	
1982-07-13	PelNA-JavNA-JavNA-PelNA-Pel1p	3	G54	
1982-07-14	PelNA-JukNA-JukNA-PelNA-Pel1p	3	G54	
1982-07-15	PelNB-PelNA-PelNB-PelNA	3	G54	
1982-07-16	JukNA-PelNA-PelNA-JukNA	3	G54	
1982-07-17	JukNA-KabAA-KabAA-JukNA	3	G54	
1982-07-18	JukNA-BjoNA-BjoNA-JukNA	3	G54	
1982-07-22	BjoNA-JukNA-JukNA-BjoNA	3	G54	
1982-07-23	JukNA-KviNA-KviNA-JukNA	3	G54	
1982-07-24	JukNA-KiK1p-JukNA-KiK1p-KiK1p	3	G54	
1982-07-25	KabAA-Kab1p-KabAA-Kab1p	3	G54	
1982-07-26	KabAA-StenA-StenA-KabAA	3	G54	
1982-07-27	KabAA-JavNA-JavNA-KabAA	3	G54	
1982-07-28	StenA-KabAA-KabAA-StenA	3	G54	
1982-07-30	OstAB-StugB-StugB-OstAB	3	G54	
1982-07-31	OstAB-FollA-FollA-OstAB	3	G54	
1982-08-01	AlvdA-Sar1p-AlvdA	3	G54	
1982-08-04	MarAA-OsthA-OsthA-MarAA		G54	
1982-08-06	OsthA-MarAA-MarAA-OsthA		G54	

1982-10-06	Got1p-GotNB-Got1p-GotNB-GotNB-Got1p-GotNB-Got1p	2	G290	Y
1982-10-08	GotNB-HoorA-HoorA-GotNB	2	G290	
1982-10-17	HoorA-GotNB-GotNB-HoorA	2	G290	
1982-10-20	SolvA-VasNA-VasNA-SolvA	2	G290	
1982-10-06	Got1p-GotNB-Got1p-GotNB-GotNB-Got1p-GotNB-Got1p	2	G54	T
1982-10-08	GotNB-HoorA-HoorA-GotNB	2	G54	
1982-10-17	HoorA-GotNB-GotNB-HoorA	2	G54	
1982-10-20	SolvA-VasNA-VasNA-SolvA	2	G54	
1983-04-19	OdeNA-Jon1p-Jon1p-OdeNA	2	G290L	Y
1983-04-19	OdeNA-Jon1p-Jon1p-OdeNA	2	G54L	Y
1984-05-22	VisNA-Tin1p-Bunge-Gothe-Garde-Hem1p-Grotl-VisNA	2	G290L	Y
1984-05-24	VisNA-Bunge-Gotsk	2	G290L	
1984-05-28	Gotsk-Bunge-VisNA	2	G290L	
1984-05-29	VisNA-Grotl-Hem1p-Garde-Gothe-Bunge-Tin1p-VisNA	2	G290L	
1984-05-31	VisNA-VisNB-Garde-Gothe-VisNA	2	G290L	
1984-06-01*	VisNA-VisNB-VisNA-VisNB-VisNA	2	G290Y	Y
1984-06-05*	SodNA-SodNB-SodNA-SodNB-SodNA	2	G290Y	
1984-06-11*	OdeNB-OdeNA-OdeNB-OdeNA-OdeNB	2	G290Y	
1984-06-11*	OdeNA-OdeNB-OdeNA-OdeNB-OdeNA	2	G290Y	
1984-06-12*	OdeNB-OdeNA-OdeNB-OdeNA-OdeNB-OdeNA	2	G290Y	
1984-06-14*	VasNA-VasNB-VasNA-VasNB-VasNA	2	G290Y	
1984-06-14*	VasNB-VasNA-VasNB-VasNA-VasNB	2	G290Y	
1984-05-22	VisNA-Tin1p-Bunge-Gothe-Garde-Hem1p-Grotl-VisNA	2	G54L	Y
1984-05-24	VisNA-Bunge-Gotsk	2	G54L	
1984-05-28	Gotsk-Bunge-VisNA	2	G54L	
1984-05-29	VisNA-Grotl-Hem1p-Garde-Gothe-Bunge-Tin1p-VisNA	2	G54L	
1984-05-31	VisNA-VisNB-Garde-Gothe-VisNA	2	G54L	
1984-06-01*	VisNA-VisNB-VisNA-VisNB-VisNA	2	G54Y	
1984-06-05*	SodNA-SodNB-SodNA-SodNB-SodNA	2	G54Y	
1984-06-11*	OdeNB-OdeNA-OdeNB-OdeNA-OdeNB	2	G54Y	
1984-06-11*	OdeNA-OdeNB-OdeNA-OdeNB-OdeNA	2	G54Y	
1984-06-14*	VasNA-VasNB-VasNA-VasNB-VasNA	2	G54Y	
1984-06-14*	VasNB-VasNA-VasNB-VasNA-VasNB	2	G54Y	

1984-08-27*	MarAA-MartB-MarAA-MartB-MarAA-MartB- MarAA-MartB-MarAA-MartB-MarAA-MartB	2	G290Y	Y
1985-05-09	GotNB-Uddev-Tanum-DalsE-Uddev-GotNB	2	G290L	Y
1985-05-10	Uddev-DalsE-Tanum-Uddev-GotNB	2	G290L	
1985-05-15	KarNA-DalsE-AarAA-Arvik-KarNA	2	G290L	
1985-05-16	KarNA-Arvik-DalsE-KarNA	2	G290L	
1985-05-17	KarNA-MunAA-Eksha-Torsb	2	G290L	
1985-05-18	KarNA-SafAA-Torsb-Eksha-MunAA-KarNA	2	G290L	
1985-05-20	KarNA-MunAA-Eksha-MunAA-KarNA	2	G290L	
1985-05-09	GotNB-Uddev-Tanum-DalsE-Uddev-GotNB	2	G54L	Y
1985-05-10	GotNB-Uddev-DalsE-Tanum-Uddev-GotNB	2	G54L	
1985-05-15	KarNA-SafAA-DalsE-AarAA-Arvik-KarNA	2	G54L	
1985-05-16	KarNA-Arvik-AarAA-DalsE-SafAA-KarNA	2	G54L	
1985-05-17	KarNA-MunAA-Eksha-Torsb-SafAA-KarNA	2	G54L	
1985-05-18	KarNA-SafAA-Torsb-KarNA	2	G54L	
1985-05-20	KarNA-MunAA-Eksha-MunAA-KarNA	2	G54L	
1985-09-01*	KviNA-KviNB- KviNA-KviNB- KviNA-KviNB- KviNA-KviNB-KviNA-KviNB-KviNA	2	G290Y	Y
1985-09-04*	KabNB-KabAA-KabNB-KabAA	2	G290Y	
1985-09-04*	KabAA-KabNB- KabAA-KabNB	2	G290Y	
1985-09-09*	BjoNB-BjoNA- BjoNB-BjoNA- BjoNB-BjoNA	2	G290Y	
1985-09-09*	BjoNA-BjoNB-BjoNA- BjoNB-BjoNA-BjoNB	2	G290Y	
1985-09-14*	JukNA-JukNB- JukNA-JukNB- JukNA-JukNB- JukNA-JukNB-JukNA-JukNB	2	G290Y	
1985-09-18*	JavNA-JavNB- JavNA-JavNB- JavNA-JavNB- JavNA-JavNB-JavNA-JavNB	2	G290Y	
1985-09-01*	KviNA-KviNB- KviNA-KviNB- KviNA-KviNB- KviNA-KviNB-KviNA-KviNB-KviNA	2	G54Y	Y
1985-09-04*	KabNB-KabAA-KabNB-KabAA	2	G54Y	
1985-09-04*	KabAA-KabNB- KabAA-KabNB	2	G54Y	
1985-09-09*	BjoNB-BjoNA- BjoNB-BjoNA- BjoNB-BjoNA	2	G54Y	
1985-09-09*	BjoNA-BjoNB-BjoNA- BjoNB	2	G54Y	
1985-09-14*	JukNA-JukNB- JukNA-JukNB- JukNA-JukNB- JukNA-JukNB-JukNA-JukNB	2	G54Y	

1985-09-18*	JavNA-JavNB- JavNA-JavNB- JavNA-JavNB- JavNA-JavNB- JavNA-JavNB	2	G54Y	
1987-09-18	FollA-StugB-KraAB	2	G290L	Y
1987-09-19	KraAB-StugB-FollA	2	G290L	
1987-09-22	FollA-StugB-KraAB	2	G290L	
1987-09-25**	KraAB-StugB-FollA	2	G290L	
1987-10-05	FollA-StugB-KraAB	2	G290L	
1987-10-06	KraAB-StugB-FollA	2	G290L	
1987-09-18	FollA-StugB-KraAB	2	G54L	Y
1987-09-19	KraAB-StugB-FollA	2	G54L	
1987-09-22	FollA-StugB-KraAB	2	G54L	
1987-09-25**	KraAB-StugB-FollA	2	G54L	
1987-10-05	FollA-StugB-KraAB	2	G54L	
1987-10-06	KraAB-StugB-FollA	2	G54L	
1988-05-26*	LyckA-LyckC- LyckA-LyckC- LyckA-LyckC- LyckA-LyckC- LyckA	2	G290Y	Y
1988-05-25*	LyckA-LyckC- LyckA-LyckC- LyckA-LyckC- LyckA-LyckC- LyckA	2	G54Y	Y
1990-05-24	KarNA-LaxAA-Orebr-Linde-Bofor-KarNA	2	G290L	Y
1990-05-25	KarNA-FreAA-Ludvi-Gryth-KarNA	2	G290L	
1990-05-26	KarNA-Bofor-Linde-Orebr-LaxAA-KarNA	2	G290L	
1990-05-27	KarNA-Gryth-Ludvi-FreAA-KarNA	2	G290L	
1990-05-28	KarNA-Bofor-Orebr-Orebr-Bofor-KarNA	2	G290L	
1990-05-29	Orebr-Ore1p-Ore1p-Orebr	2	G290L	Y
1990-06-02	SodNA-Enkop-Halls-Eskil-SodNA	2	G290L	Y
1990-06-03	SodNA-Eskil-Halls-SodNA	2	G290L	
1990-06-04	SodNA-Enkop-Solna-Jordb-SodNA	2	G290L	
1990-06-05	SodNA-Jordb-MarAA	2	G290L	
1990-05-24	KarNA-LaxAA-Orebr-Linde-Bofor-KarNA	2	G54L	Y
1990-05-25	KarNA-FreAA-Ludvi-Gryth-KarNA	2	G54L	
1990-05-26	KarNA-Bofor-Linde-Orebr-LaxAA-KarNA	2	G54L	
1990-05-27	KarNA-Gryth-Ludvi-FreAA-KarNA	2	G54L	
1990-05-28	KarNA-Bofor-Orebr-Orebr-Bofor-KarNA	2	G54L	
1990-05-29	Orebr-Ore1p-Ore1p-Orebr	2	G54L	Y

1990-06-02	SodNA-Enkop-Halls-Eskil-SodNA	2	G54L	Y
1990-06-03	SodNA-Eskil-Halls-Enkop-SodNA	2	G54L	
1990-06-04	SodNA-Enkop-Solna-Jordb-SodNA	2	G54L	
1990-06-05	SodNA-Jordb-Solna-MarAA	2	G54L	
1991-06-15	SkeAA-JavNA-JavNA-SkeAA- SkeAA-JavNA-JavNA-SkeAA	2	G290L	Y
1991-06-16*	SkeAA-SavAA-SavAA-SkeAA	2	G290L	Y
1991-06-18*	SkeAA-SavAA-SavAA-SkeAA	2	G290L	Y
1991-06-15	SkeAA-JavNA-JavNA-SkeAA	2	G54L	Y
1991-06-15	SkeAA-JavNA-JavNA-SkeAA	2	G54L	
1991-06-16	SkeAA-SavAA-SavAA-SkeAA	2	G54L	Y
1991-06-18	SkeAA-SavAA-SavAA-SkeAA	2	G54L	
1992-09-21	LyckA-Fredr-Asele-Vilhe-VilAA-Vinli-LyckA	2	G290L	Y
1992-09-24	LyckA-Vinli-Vilhe-VilAA-Asele-Fredr-LyckA	2	G290L	
1992-09-25	LyckA-Vinli-StenA	2	G290L	
1992-09-26	StenA-Vilhe-Saxna-Steke-Saxna-Vilhe-StenA	2	G290L	
1992-09-27	StenA-VilAA-Vilhe-Saxna-Saxna-Vilhe-StenA	2	G290L	
1992-09-29	FollA-Str1p-SvdAA-Gadde-FollA	2	G290L	
1992-09-30	FollA-Str1p-Hotin-Hotin-Str1p-FollA	2	G290L	
1992-10-01	FollA-SvdAA-Gadde-Gadde-SvdAA-FollA	2	G290L	
1992-10-02	FollA-Hotin-Hallv-FollA	2	G290L	
1992-09-21	LyckA-Fredr-Asele-Vilhe-VilAA-Vinli-LyckA	2	G54L	Y
1992-09-24	LyckA-Vinli-Vilhe-VilAA-Asele-Fredr-LyckA	2	G54L	
1992-09-25	LyckA-Vinli-StenA	2	G54L	
1992-09-26	StenA-Vilhe-Saxna-Steke-Saxna-Vilhe-StenA	2	G54L	
1992-09-27	StenA-VilAA-Vilhe-Saxna-Saxna-Vilhe-StenA	2	G54L	
1992-09-29	FollA-Str1p-SvdAA-Gadde-FollA	2	G54L	
1992-09-30	FollA-Str1p-Hotin-Hotin-Str1p-FollA	2	G54L	
1992-10-01	FollA-SvdAA-Gadde-Gadde-SvdAA-FollA	2	G54L	
1992-10-02	FollA-Hotin-Hallv-FollA	2	G54L	
1993-09-03	KraAB-StugB-FollA	2	G290L	Y
1993-09-24**	KraAB-StugB-KraAB	2	G290L	
1993-10-10	KraAB-StugB-KraAB	2	G290L	
1993-10-16	KraAB-StugB-FollA-StugB	2	G290L	

1993-10-17	StugB-FollA-StugB-FollA	2	G290L	
1993-10-18	FollA-StugB-KraAB	2	G290L	
1993-09-03	KraAB-StugB-FollA	2	G54L	Y
1993-09-24**	KraAB-StugB-KraAB	2	G54L	
1993-10-10	KraAB-StugB-KraAB	2	G54L	
1993-10-16	KraAB-StugB-FollA-StugB	2	G54L	
1993-10-17	StugB-FollA-StugB-FollA	2	G54L	
1993-10-18	FollA-StugB-KraAB	2	G54L	
1995-08-25	JukNA-KirAA-KirAA-JukNA-KirAA-JukNA	2	G290L	Y
1995-08-24	KiK1p-JukNA-KirAA	2	G54L	Y
1995-08-25	KirAA-JukNA-KirAA-JukNA	2	G54L	
1996-05-17-18	KarNA-StoAA-Syssl-NNy1p-StoAA-Syssl-StoAA-NRa1p-KarNA	2	G290L	Y
1996-05-19	KarNA-StoAA-Malun-Trans-AlvdA-AlvAA	2	G290L	
1996-05-20	AlvdA-Trans-Malun-VanAA-AlvdA	2	G290L	
1996-05-17-18	KarNA-StoAA-Syssl-NNy1p-StoAA-Syssl-StoAA-NRa1p-KarNA	2	G54L	Y
1996-05-19	KarNA-StoAA-Malun-Trans-AlvdA-AlvAA	2	G54L	
1996-05-20	AlvdA-Trans-Malun-VanAA-AlvdA	2	G54L	
2001-05-02	HofoB-Avest-Tarns-Uppsa-Norrt-OsthA		G290Y	Y
2001-05-03	OsthA-Norrt-Uppsa-Tarns-Avest-HofoB		G290Y	
2001-06-12	HofoB-Avest-Uppsa-MarAA		G290Y	Y
2001-05-02	HofoB-Avest-Tarns-Uppsa-Norrt-OsthA		G54Y	Y
2001-05-03	OsthA-Norrt-Uppsa-Tarns-Avest-HofoB		G54Y	
2001-06-12	HofoB-Avest-Uppsa-MarAA		G54Y	Y
2001-06-19	AlvdA-Sarna-Idree-Lofsd-AlvdA	1	G290Y	Y
2001-06-20	AlvdA-Lofsd-Idree-Sarna-AlvdA	1	G290Y	
2001-06-19	AlvdA-Sarna-Idree-Lofsd-AlvdA	1	G54Y	Y
2001-06-20	AlvdA-Lofsd-Idree-Sarna-AlvdA	1	G54Y	
2001-06-26	StugA-Kroko-StugA	1	G290Y	Y
2001-06-27	StugA-Kroko-StugA	1	G290Y	Y
2001-06-26	StugA-Jarpe-Aannn-Kroko-StugA	1	G54Y	Y
2001-06-27	StugA-Kroko-Aannn-Jarpe-StugA	1	G54Y	
2001-07-04	StenB-Sorse-Arjep-Jakkv-StenB	1	G290Y	Y
2001-07-05	StenB-Strom-Tarna-StenB	1	G290Y	

2001-07-06	KabAA-Arvid-Burtr-JavNB-KabAA	1	G290Y	
2001-07-07	KabAA-KviNB-Jokkm-KabAA	1	G290Y	
2001-07-08	KabAA-JavNB-Burtr-Arvid-KabAA	1	G290Y	
2001-07-09	StenB-Tarna-Strom-StenB	1	G290Y	
2001-07-10	StenB-Jakkv-Arjep-Sorse-StenB	1	G290Y	
2001-07-04	StenB-Sorse-Arjep-Jakkv-StenB	1	G54Y	Y
2001-07-05	StenB-Strom-Tarna-StenB	1	G54Y	
2001-07-06	KabAA-Arvid-Burtr-JavNB-KabAA	1	G54Y	
2001-07-07	KabAA-KviNB-Jokkm-KabAA	1	G54Y	
2001-07-08	KabAA-JavNB-Burtr-Arvid-KabAA	1	G54Y	
2001-07-09	StenB-Tarna-Strom-StenB	1	G54Y	
2001-07-10	StenB-Jakkv-Arjep-Sorse-StenB	1	G54Y	
2001-07-16	HofoB-Borla-Rattv-Moraa-AlvdA	1	G290Y	Y
2001-07-17	AlvdA-Tanna-Hedee-Svegg-Tands-AlvdA	1	G290Y	
2001-07-18	AlvdA-Tands-Svegg-Hedee-Tanna-AlvdA	1	G290Y	
2001-07-19	AlvdA-Moraa-Rattv-Borla-HofoB	1	G290Y	
2001-07-16	HofoB-Borla-Rattv-Moraa-AlvdA	1	G54Y	Y
2001-07-17	AlvdA-Tanna-Hedee-Svegg-Tands-AlvdA	1	G54Y	
2001-07-18	AlvdA-Tands-Svegg-Hedee-Tanna-AlvdA	1	G54Y	
2001-07-19	AlvdA-Moraa-Rattv-Borla-HofoB	1	G54Y	
2001-07-28	KabAA-Jokkm-KabAA	1	G290Y	Y
2001-07-29	JukNA-Galli-Porju-Vitta-Torne-JukNA	1	G290Y	
2001-07-30	JukNA-Torne-Vitta-Porju-Galli-JukNA	1	G290Y	Y
2001-07-28	KabAA-Jokkm-KabAA	1	G54Y	Y
2001-07-29	JukNA-Galli-Porju-Vitta-Torne-JukNA	1	G54Y	
2001-07-30	JukNA-Torne-Vitta-Porju-Galli-JukNA	1	G54Y	
2001-08-09	StugA-SvnAA-Ratby-StugA	1	G290Y	Y
2001-08-10	StugA-Ratby-SvnAA-StugA	1	G290Y	
2001-08-09	StugA-SvnAA-Ratby-Jarpe-StugA	1	G54Y	Y
2001-08-10	StugA-Ratby-SvnAA-StugA	1	G54Y	
2001-09-18	StenB-Ammar-StenB	1	G290Y	Y
2001-09-19	StenB-Ammar-StenB	1	G290Y	
2001-09-20	UmbuA-Hemav-UmbuA-UmbuA-Hemav-UmbuA	1	G290Y	

2001-09-18	StenB-Ammar-StenB	1	G54Y	Y
2001-09-19	StenB-Ammar-StenB	1	G54Y	Y
2001-09-20	UmbuA-Hemav-UmbuA-UmbuA-Hemav-UmbuA	1	G54Y	
2002-06-24	MarAA-Vallv-Gnarp-BBrAA-MarAA	1	G290Y	Y
2002-06-29	MarAA-BBrAA-Gnarp-Vallv-MarAA	1	G290Y	
2002-06-24	MarAA-Vallv-Gnarp-BBrAA-MarAA	1	G54Y	Y
2002-06-29	MarAA-BBrAA-Gnarp-Vallv-MarAA	1	G54Y	
2002-07-02	LyckA-Malaa-Norsj-Halln-BjuAA-LyckA	1	G290Y	Y
2002-07-03	JavNB-Bergn-Hapar-Kalix-JavNB	1	G290Y	
2002-07-04	JavNB-Alvsb-Edefo-HunAA-JavNB	1	G290Y	
2002-07-05	JavNB-HunAA-Edefo-JavNB	1	G290Y	
2002-07-06	JavNB-Kalix-Hapar-Bergn-JavNB	1	G290Y	
2002-07-07	LyckA-BjuAA-Halln-Norsj-Malaa-LyckA	1	G290Y	
2002-07-02	LyckA-Malaa-Norsj-Halln-BjuAA-LyckA	1	G54Y	Y
2002-07-03	JavNB-Bergn-Hapar-Kalix-JavNB	1	G54Y	
2002-07-04	JavNB-Alvsb-Edefo-HunAA-JavNB	1	G54Y	
2002-07-05	JavNB-HunAA-Edefo-Alvsb-JavNB	1	G54Y	
2002-07-06	JavNB-Hapar-Bergn-JavNB	1	G54Y	
2002-07-07	LyckA-BjuAA-Halln-Norsj-Malaa-LyckA	1	G54Y	
2002-07-11	SodNA-ValAA	1	G290Y	Y
2002-07-11	NorAA-NykAA-SodNA	1	G290Y	
2002-07-13	HoorB-Lahol-Torup-Lagan-Osbyy-HoorB	1	G290Y	
2002-07-14	HoorB-Osbyy-Lagan-Torup-Lahol-HoorB	1	G290Y	
2002-07-15	HoorB-SimAA-Astor-HoorB	1	G290Y	
2002-07-16	HoorB-Astor-Dalby-SimAA-HoorB	1	G290Y	
2002-07-17	SolvA-Urshu-EmmAA-Johan-SolvA	1	G290Y	
2002-07-18	SolvA-Johan-EmmAA-Urshu-SolvA	1	G290Y	
2002-07-19	SodNA-NykAA-NorAA-ValAA-SodNA	1	G290Y	
2002-07-11	SodNA-ValAA-NorAA-NykAA-SodNA	1	G54Y	Y
2002-07-13	HoorB-Lahol-Torup-Lagan-Osbyy-HoorB	1	G54Y	
2002-07-14	HoorB-Osbyy-Lagan-Torup-Lahol-HoorB	1	G54Y	
2002-07-16	HoorB-Astor-Dalby-SimAA-HoorB	1	G54Y	
2002-07-17	SolvA-Urshu-EmmAA-Johan-SolvA	1	G54Y	

2002-07-18	SolvA-Johan-EmmAA-Urshu-SolvA	1	G54Y	
2002-07-19	SodNA-NykAA-NorAA-ValAA-SodNA	1	G54Y	
2002-07-15	HoorB-SimAA-Astor-HoorB	1	G54Y	Y
2002-07-24	Arbra-Lafor-Hyboo	1	G290Y	Y
2002-07-25	MarAA-Hyboo-Lafor-Arbra-MarAA	1	G290Y	
2002-07-24	MarAA-Arbra-Lafor-Hyboo-MarAA	1	G54Y	Y
2002-07-28	KraAB-Stavv-Ramse-Gulse-Solle-KraAB	1	G290Y	Y
2002-07-29	KraAB-Solle-Gulse-Ramse-Stavv-KraAB	1	G290Y	
2002-07-30	KraAB-Aatee-Bjorn-HonAA-KraAB	1	G290Y	
2002-07-31	KraAB-HonAA-Bjorn-Aatee-KraAB	1	G290Y	
2002-08-01	StugA-Stavr-Albyy-Torps-Bodaa-StugA	1	G290Y	
2002-08-02	StugA-Bodaa-Torps-Albyy-Stavr-StugA	1	G290Y	
2002-07-28	KraAB-Stavv-Ramse-Gulse-Solle-KraAB	1	G54Y	Y
2002-07-29	KraAB-Solle-Gulse-Ramse-Stavv-KraAB	1	G54Y	
2002-07-30	KraAB-Aatee-Bjorn-HonAA-KraAB	1	G54Y	
2002-07-31	KraAB-HonAA-Bjorn-Aatee-KraAB	1	G54Y	
2002-08-01	StugA-Stavr-Albyy-Torps-Bodaa-StugA	1	G54Y	
2002-08-02	StugA-Bodaa-Torps-Albyy-Stavr-StugA	1	G54Y	Y
2002-08-08*	MarAA-Aamot-Voxna-MarAA	4	G290Y	Y
2002-08-10	JavNB-Lovan-JavNB	4	G290Y	
2002-08-11	PelNA-Junos-Pajal-PelNA	4	G290Y	
2002-08-12	PelNA-Lansa-Hakka-JukNA	4	G290Y	
2002-08-13	JukNA-Soppe-Kares-JukNA	4	G290Y	
2002-08-14	JukNA-Kares-Soppe-JukNA	4	G290Y	
2002-08-15	JukNA-Hakka-Lansa-PelNA	4	G290Y	
2002-08-16	PelNA-Pajal-Junos-Korpi-OveAA-PelNA	4	G290Y	
2002-08-17	JavNB-Lovan-Lidtr-JavNB	4	G290Y	
2002-08-08*	MarAA-Aamot-Voxna-MarAA	4	G54Y	Y
2002-08-10	JavNB-Lidtr-Lovan-JavNB	4	G54Y	
2002-08-11	PelNA-OveAA-Korpi-Pajal-PelNA	4	G54Y	
2002-08-12	PelNA-Lansa-Hakka-JukNA	4	G54Y	
2002-08-13	JukNA-Soppe-Kares-JukNA	4	G54Y	
2002-08-14	JukNA-Kares-Soppe-JukNA	4	G54Y	

2002-08-15	JukNA-Hakka-Lansa-PelNA	4	G54Y	
2002-08-16	PelNA-Pajal-Junos-Korpi-OveAA-PelNA	4	G54Y	
2002-08-17	JavNB-Lovan-Lidtr-JavNB	4	G54Y	
2002-08-22	OdeNA-Motal-LjfAA-Atvid-Kisaa-OdeNA	4	G290Y	Y
2002-08-23	OdeNA-Bottn-MstAA-Dalaa-OdeNA	4	G290Y	
2002-08-24	OdeNA-Aneby-Savsj-Oeroe-Hille-OdeNA	4	G290Y	
2002-08-25	OdeNA-Hille-Oeroe-Savsj-Aneby-OdeNA	4	G290Y	
2002-08-26	OdeNA-Dalaa-MstAA-VarAA-Bottn-OdeNA	4	G290Y	
2002-08-27	OdeNA-Kisaa-Atvid-LjfAA-Motal-OdeNA	4	G290Y	
2002-08-28	VasNA-MisAA-Bloms-Aseda-Lonne-VasNA	4	G290Y	
2002-08-29	VasNA-Kastl-Borgh-Torsa-VasNA	4	G290Y	
2002-09-02	VasNA-Torsa-Borgh-VasNA	4	G290Y	
2002-09-03	VasNA-Lonne-Aseda-Bloms-MisAA-VasNA	4	G290Y	
2002-09-05	MarAA-Voxna-Aamot-MarAA	4	G290Y	
2002-08-22	OdeNA-Motal-LjfAA-Atvid-Kisaa-OdeNA	4	G54Y	Y
2002-08-23	OdeNA-Bottn-VarAA-MstAA-Dalaa-OdeNA	4	G54Y	
2002-08-24	OdeNA-Aneby-Savsj-Oeroe-Hille-OdeNA	4	G54Y	
2002-08-25	OdeNA-Hille-Oeroe-Savsj-Aneby-OdeNA	4	G54Y	
2002-08-26	OdeNA-Dalaa-MstAA-VarAA-Bottn-OdeNA	4	G54Y	
2002-08-27	OdeNA-Kisaa-Atvid-LjfAA-Motal-OdeNA	4	G54Y	
2002-08-28	VasNA-MisAA-Bloms-Aseda-Lonne-VasNA	4	G54Y	
2002-08-29	VasNA-Kastl-Borgh-Torsa-VasNA	4	G54Y	
2002-09-02	VasNA-Torsa-Borgh-Kastl-VasNA	4	G54Y	
2002-09-03	VasNA-Lonne-Aseda-Bloms-MisAA-VasNA	4	G54Y	
2002-09-05	MarAA-Voxna-Aamot-MarAA	4	G54Y	
2002-10-10	GotNB-Boras-Svenl-Veddi-GotNB	1	G290Y	Y
2002-10-11	GotNB-Veddi-Svenl-Boras-GotNB	1	G290Y	
2002-10-10	GotNB-Boras-Veddi-GotNB	1	G54Y	Y
2002-10-11	GotNB-Veddi-Svenl-Boras-GotNB	1	G54Y	
2003-08-30	KraAB-StugB-FollA	1	G290Y	Y
2003-09-02	FollA-StugB-KraAB	1	G290Y	
2003-09-08	KraAB-KraAB-StugB-FollA	1	G290Y	
2003-09-11	FollA-StugB-KraAB	1	G290Y	

2003-09-20	KraAB-StugB-FollA	1	G290Y	
2003-09-23	FollA-StugB-KraAB	1	G290Y	
2003-09-19	KraAB-KraAA-KraAB	1	G290Y	Y
2003-09-28	KraAB-KraAA-KraAB	1	G290Y	
2003-08-30	KraAB-StugB-FollA	1	G54Y	Y
2003-09-02	FollA-StugB-KraAB	1	G54Y	
2003-09-08	KraAB-StugB-FollA	1	G54Y	
2003-09-11	FollA-StugB-KraAB	1	G54Y	
2003-09-20	KraAB-StugB-FollA	1	G54Y	
2003-09-23	FollA-StugB-KraAB	1	G54Y	
2003-09-19	KraAB-KraAA-KraAB	1	G54Y	Y
2003-09-28	KraAB-KraAA-KraAB	1	G54Y	
2003-08-30	KraAB-StugB-FollA	4	GNordic	Y
2003-09-02	FollA-StugB-KraAB	4	GNordic	
2003-09-08	KraAB-StugB-FollA	4	GNordic	
2003-09-11	FollA-StugB-KraAB	4	GNordic	
2003-09-20	KraAB-StugB-FollA	4	GNordic	
2003-09-23	FollA-StugB-KraAB	4	GNordic	
2003-09-19	KraAB-KraAA-KraAB	4	GNordic	Y
2003-09-28	KraAB-KraAA-KraAB	4	GNordic	
2003-08-30	KraAB-StugB-FollA	4	GNordic	Y
2003-09-02	FollA-StugB-KraAB	4	GNordic	
2003-09-08	KraAB-StugB-FollA	4	GNordic	
2003-09-11	FollA-StugB-KraAB	4	GNordic	
2003-09-20	KraAB-StugB-FollA	4	GNordic	
2003-09-23	FollA-StugB-KraAB	4	GNordic	
2003-09-19	KraAB-KraAA-KraAB	4	GNordic	
2003-09-28	KraAB-KraAA-KraAB	4	GNordic	
2003-10-24	HelsR-HoorB-SolvA-SolvA-HoorB-HelsR	1	G54Y	Y
2003-10-27	HelsR-HoorB-SolvA-SolvA-HoorB-HelsR	1	G54Y	
2003-10-24	HelsR-HoorB-SolvA-SolvA-HoorB-HelsR	1	GNordic	Y
2003-10-27	HelsR-HoorB-SolvA-SolvA-HoorB-HelsR	1	GNordic	
2004-05-27	VisNA-VisAA-VisNA	1	G54Y	Y

2004-05-27	VisNA-VisAA-VisNA	1	G54Y	
2004-05-27	VisNA-VisAA-VisNA	1	G54Y	
2004-06-29	MarAA-KraAA-KraAA-MarAA	1	G54Y	Y
2004-07-06	FollB-OstAA-FollB	1	G54Y	Y
2004-07-07	FollB-OstAA-FollB	1	G54Y	
2004-07-07	FollB-OstAA-FollB	1	G54Y	
2004-07-09	KabAA-ArjAA-KabAA	1	G54Y	
2004-07-10	KabAA-ArjAA-KabAA	1	G54Y	
2004-07-11	KabAA-ArjAA-KabAA	1	G54Y	
2004-07-12	JukNA-KirAA-JukNA	1	G54Y	
2004-07-13	JukNA-KirAA-JukNA	1	G54Y	
2004-07-13	JukNA-KirAA-JukNA	1	G54Y	
2004-07-14	JavNA-SkeAA-JavNA	1	G54Y	
2004-07-14	JavNA-SkeAA-JavNA	1	G54Y	
2004-07-15	JavNA-SkeAA-JavNA	1	G54Y	
2011-04-27	MstAA-VarAA-VarAA-MstAA	1	G54Y	Y
2013-04-20	BorAA-Boras-Bor1p-BorAA	1	G54Y	Y
2013-04-21	BorAA-Bor1p-Boras-BorAA	1	G54Y	
2013-05-01	OnsAA-GotNB-GotNB-OnsAA	1	G54Y	Y
2013-05-01	GotNB-GriAA-GriAA-GotNB	1	G54Y	
2013-05-02	Var1p-VeiAA-VeiAA-Var1p	1	G54Y	Y
2013-05-03	OnsAA-Var1p-Veddi-OnsAA	1	G54Y	
2015-06-16	Sku1p-MarAA-MarAA-Sku1p	1	G54X	Y
2015-06-17	OsthA-NtjAA- NtjAA-OsthA	1	G54X	
2015-06-18	OreAA-OsthA-OsthA-OreAA	1	G54X	Y
2015-06-22	Torps-BrgAA-BrgAA-Torps	1	G54X	Y
2015-06-23	RagAA-StugA-StuAA-StuAA-StugA-RagAA	1	G54X	
2015-06-23	RagAA-Solle	1	G54X	
2015-06-23	Solle-SlfAA-SlfAA-Solle	1	G54X	
2015-06-24	JunAA-Gulse-AseAA	1	G54X	
2015-06-24	AseAA-Saxna	1	G54X	
2015-06-24	Saxna-KliAA-KliAA-Saxna	1	G54X	
2015-06-25	Tarna-UmbAA-UmbAA-Tarna	1	G54X	

2015-06-25	UmbAA-UmbuA-UmbuA-UmbAA	1	G54X	
2015-06-26	StenB-SorAA-SorAA-StenB	1	G54X	
2015-06-26	StenB-SteAA-SteAA-StenB	1	G54X	
2015-06-27	AseAA-Gulse-JunAA	1	G54X	
2015-06-27	JunAA-Stavv	1	G54X	
2015-06-27	Stavv-SunAA-SunAA-Stavv	1	G54X	
2015-08-03	BolAA-Arbra-Arbra-BolAA	1	G54X	Y
2015-08-03	VoxAA-Voxna-Voxna-VoxAA	1	G54X	
2015-08-04	TraAA-Trans-Trans-TraAA	1	G54X	
2015-08-04	TraAA-AlvAA	1	G54X	
2015-08-04	AlvAA-AlvdA-AlvdA-AlvAA	1	G54X	
2015-08-06	GryAA-Avest-Avest-GryAA	1	G54X	
2015-08-06	GryAA-LekAA	1	G54X	
2015-08-06	LekAA-Borla-Borla-LekAA	1	G54X	
2015-08-10	HarAA-KraAB-OrnAA	1	G54X	Y
2015-08-11	Alvsb-AlbAA-AlbAA-Alvsb	1	G54X	
2015-08-11	Bergn-LulAA-LulAA-Bergn	1	G54X	
2015-08-13	Hapar-HapAA-HapAA-Hapar	1	G54X	
2015-08-14	Paj1p-Pajal-TarAA-TarAA-Pajal-Paj1p	1	G54X	
2015-08-14	Paj1p-KsuAA	1	G54X	
2015-08-14	KsuAA-Kares-Kares-KsuAA	1	G54X	
2015-08-15	Galli-GalAA-GalAA-Galli	1	G54X	
2015-08-15	Galli-Arvid	1	G54X	
2015-08-15	Arvid-ArvAA-ArvAA-Arvid	1	G54X	
2015-08-16	Norsj-NsjAA-NsjAA-Norsj	1	G54X	
2015-08-17	OrnAA-KraAB-HarAA	1	G54X	
2015-09-01	RatAA-SavAA-SavAA-RatAA	1	G54X	Y
2015-09-02	RatAA-HolAA-HolAA-RatAA	1	G54X	
2015-09-04	KirAA-JukNA-JukNA-KirAA	1	G54X	
2015-09-15	SkeAA-BurAA-BurAA-SkeAA	1	G54X	Y
2015-09-19	LycAA-LyckA-LyckA-LycAA	1	G54X	
2015-09-21	OstAA-HamAA-HamAA-OstAA	1	G54X	
2015-09-22	OstAA-OstAB-OstAB-OstAA	1	G54X	

2015-10-05	SolAA-Solna-Solna-SolAA	1	G54X	Y
2015-10-05	SolAA-RimAA	1	G54X	
2015-10-05	RimAA-Kisaa-Kisaa-RimAA	1	G54X	
2015-10-06	Aseda-VirAA-VirAA-Aseda	1	G54X	
2015-10-07	FalAA-Veddi-Veddi-FalAA	1	G54X	
2015-10-07	BalAA-Dalaa-Dalaa-BalAA	1	G54X	
2015-10-08	KloAA-DalsE-TanAA-TanAA-DalsE-KloAA	1	G54X	
2015-10-14	LMVAA-HusAA-LMVAA	1	G54X	Y
2016-04-05	SviAA-Halls-Halls-SviAA	1	G54X	Y
2016-04-05	Halls-ArbAA-ArbAA-Halls	1	G54X	
2016-04-11	Sko1p-NorAA-OdeNA-VToAA-VToAA-OdeNA-NorAA-Sko1p	1	G54X	Y
2016-04-12	RimAA-Kisaa-Kisaa-RimAA	1	G54X	
2016-04-12	Kisa-Lonne	1	G54X	
2016-04-12	Savsj-Savsj-EksAA-Lonne-Kisaa	1	G54X	
2016-04-13	GamAA-VasNA-VasNA-GamAA	1	G54X	
2016-04-13	Bloms-MisAA-MisAA-Bloms	1	G54X	
2016-04-14	LjbAA-Borgh-Borgh-LjbAA	1	G54X	
2016-04-14	Borgh-KopAA-KopAA-Borgh	1	G54X	
2016-04-14	KopAA-Kastl-Kastl-KopAA	1	G54X	
2016-04-14	LjbAA-Bloms-Bloms-LjbAA	1	G54X	
2016-04-15	LjbAA-EmmAA-EmmAA-LjbAA	1	G54X	
2016-04-15	EmmAA-Alg1p-Alg1p-EmmAA	1	G54X	
2016-04-15	EmmAA-Torsa-Torsa-EmmAA	1	G54X	
2016-04-16	Johan-AugAA-Jam1p-AugAA-Johan	1	G54X	
2016-04-16	Stb1p-AlmAA-AlmAA-Stb1p	1	G54X	
2016-04-16	AlmAA-Osbyy-Osbyy-AlmAA	1	G54X	
2016-04-20	LMVAA-Tarns-Uppsa-LMVAA	1	G54X	Y
2016-04-21	LMVAA-Uppsa-HusAA-HusAA-Uppsa-Tarns-LMVAA	1	G54X	
2016-04-26	Linde-LjuAA-LjuAA-Linde	1	G54X	Y
2016-04-26	Orebr-ArbAA-ArbAA-Orebr	1	G54X	Y
2016-04-27	KarNA-KarAA-KarAA-KarNA	1	G54X	
2016-04-27	KarAA-Arvik-AarAA-AarAA-Arvik-KarAA	1	G54X	
2016-04-28	Orebr-LjfAA-LjfAA-Orebr	1	G54X	

2016-05-04	Hyboo-LjdAA-LjdAA-Hyboo	1	G54X	Y
2016-05-04	BBrAA-Hyboo-Hyboo-BBrAA	1	G54X	
2016-05-06	Vallv-BBrAA-BBrAA-Vallv	1	G54X	
2016-05-06	BBrAA-Gnarp-Gnarp-BBrAA	1	G54X	
2016-05-12	LMVAA-HofoB-GryAA-Avest-Avest-GryAA-HofoB-LMVAA	1	G54X	Y
2016-05-16	TulAA-SodNA-SodNA-TulAA	1	G54X	Y
2016-05-21	VisAA-VisNA-VisNA-VisAA	1	G54X	Y
2016-05-31	Gnarp-SunAA-Torps-Torps-SunAA	1	G54X	Y
2016-06-01	Kroko-Jarpe-DuvAA-Aannn-Aannn-DuvAA-Jarpe-Kroko-OstAA	1	G54X	Y
2016-06-02	HamAA-Hallv-Hotin-VilAA-VilAA-Hotin-Hallv-HamAA	1	G54X	
2016-06-03	SteAA-Strom-Tarna-Hemav-UmbAA-UmbAA-Hemav-Tarna-Strom-SteAA	1	G54X	
2016-06-04	LyckA-LycAA-LycAA-LyckA	1	G54X	
2016-06-08	LMVAA-Aamot-Aamot-LMVAA	1	G54X	Y
2016-06-20	Lin1p-Linde-Lin1p	1	G54X	Y
2016-06-20	Lin1p-Eksha	1	G54X	
2016-06-20	Eksha-FryAA-FryAA-Eksha	1	G54X	
2016-06-21	Mal1p-Malun-StoAA-StoAA-Malun-Mal1p	1	G54X	
2016-06-21	Mal1p-SarAA	1	G54X	
2016-06-21	SarAA-Idree-Idree-SarAA	1	G54X	
2016-06-22	Svegg-HedAA-Hedee-Ratby-OtuAA-OtuAA-Ratby-Hedee-HedAA-Svegg	1	G54X	
2016-07-06	LMVAA-KraAA-KraAA-LMVAA	1	G54X	Y
2016-08-09	Vallv-BolAA-Sod1p-Vallv	1	G54X	Y
2016-08-09	Vallv-Sod1p-BolAA-Vallv-LMVAA	1	G54X	
2016-08-11	Gnarp-SunAA-SunAA-Gnarp	1	G54X	
2016-08-12	BurAA-Burtr-SkeAA-Lidtr-Lidtr-SkeAA-Burtr-BurAA	1	G54X	
2016-08-14	Kalix-HunAA-Bergn-Kalix	1	G54X	
2016-08-15	GalAA-Jokkm-Jokkm-GalAA	1	G54X	
2016-08-15	Lansa-Hakka-GalAA-GalAA-JukNA	1	G54X	
2016-08-16	Vitta-Soppe-Soppe-Vitta	1	G54X	
2016-08-16	JukNA-Vitta-Vitta-JukNA	1	G54X	
2016-08-16	Vitta-Junos-TarAA-TarAA-Junos-Vitta	1	G54X	

2016-08-17	JukNA-Torne-BjoNB-BjoNB-Torne-JukNA	1	G54X	
2016-08-17	JukNA-GalAA-Hakka-Lansa	1	G54X	
2016-08-18	Kalix-HapAA-OveAA-Ove1p-OveAA-HapAA-Kalix	1	G54X	
2016-08-20	Kalix-Lansa-OveAA-PelNA-PelNA-OveAA-Lansa-Kalix	1	G54X	
2016-08-21	Kalix-Bergn-HunAA-Kalix	1	G54X	
2016-08-22	ArvAA-Malaa-NsjAA-NsjAA-Malaa-ArvAA	1	G54X	Y
2016-08-23	ArjAB-Arjep-Arjep-ArjAB	1	G54X	
2016-08-23	Arjep-ArjAA-ArjAA-Arjep	1	G54X	Y
2016-08-28	Eskil-ValAA-ValAA-Eskil	1	G54X	Y
2016-08-29	SFa1p-Dalaa-BalAA-Bottn-UlrAA-UlrAA-Bottn-BalAA-Dalaa-SFa1p	1	G54X	
2016-08-30	KrdAA-Lagan-Lagan-KrdAA	1	G54X	
2016-08-30	Lagan-OjaAA-OjaAA-Lagan	1	G54X	
2016-08-30	OjaAA-Oeroe-Oeroe-OjaAA	1	G54X	
2016-08-30	KrdAA-Svenl-Svenl-KrdAA	1	G54X	Y
2016-08-31	KrdAA-Hille-Hille-KrdAA	1	G54X	
2016-08-31	KrdAA-Torup-FalAA-FalAA-Torup-KrdAA	1	G54X	
2016-09-01	Astor-HelAA-Dalby-MagAA-MagAA-Dalby-HelAA-Astor	1	G54X	
2016-09-02	Lahol-VeiAA-VeiAA-Lahol	1	G54X	
2016-09-08	MarAA-OsthA-OsthA-MarAA	1	G54X	Y
2016-09-12	OsthA-Norrt-Norrt-OsthA	1	G54X	Y
2016-09-12	Norrt-NtjAA-NtjAA-Norrt	1	G54X	
2016-09-15	LMVAA-HusAA-HusAA-LMVAA	1	G54X	Y
2016-09-28	LMVAA-LekAA-VanAA-FreAA-GryAA-LMVAA	1	G54X	Y
2016-10-11	SviAA-HusAA-HusAA-SviAA	1	G54X	Y
2016-10-11	HusAA-NtjAA-NtjAA-HusAA	1	G54X	Y
2017-03-28	VisAA-VisNA-VisNA-VisAA	1	G54X	Y
2017-03-29	VisAA-Garde-Garde-VisAA	1	G54X	
2017-04-01	BorAA-Svenl-Svenl-BorAA	1	G54X	
2017-04-02	BorAA-Boras-Boras-BorAA	1	G54X	
2017-04-06	NorAA-Motal-Motal-NorAA	1	G54X	Y
2017-04-07	RimAA-Atvid-Atvid-RimAA	1	G54X	Y
2017-04-07	Atvid-GamAA-GamAA-Atvid	1	G54X	

2017-04-26	Uppsa-SviAA-SviAA-Uppsa	1	G54X	Y
2017-04-26	SviAA-Halls-Halls-SviAA	1	G54X	
2017-04-28	LMVAA-Vallv-Vallv-LMVAA	1	G54X	
2017-05-02	LMVAA-OsthA-OsthA-LMVAA	1	G54X	Y
2017-05-02	OsthA-OreAA-OreAA-OsthA	1	G54X	
2017-05-04	Lud1p-LjuAA-Gryth-Gryth-LjuAA-Lud1p	1	G54X	Y
2017-05-05	VanAA-TraAA-Trans-TraAA-SarAA-SarAA-TraAA-VanAA	1	G54X	Y
2017-05-07	LMVAA-Aamot-Aamot-LMVAA	1	G54X	Y
2017-05-12	LMVAA-Tarns-GryAA-GryAA-Tarns-LMVAA	1	G54X	Y
2017-05-15	Borla-StT1p-StT1p-Borla	1	G54X	
2017-08-30	LjdAA-Lafor-Ratby-Ratby-Lafor-LjdAA	1	G54X	Y
2017-08-31 - 09-01	BolAA-VoxAA-SvgAA-SvgAA-VoxAA-BolAA	1	G54X	
2017-08-31	SvgAA-Svegg-Svegg-SvgAA	1	G54X	
2017-08-31	SvgAA-Lofsd-Tanna-HedAA-Hedee-SvgAA	1	G54X	
2017-09-01	SvgAA-HedAA-Tanna-Lofsd-SvgAA	1	G54X	
2017-09-01	VoxAA-Voxna-VoxAA	1	G54X	
2017-09-25	Aneby-EksAA-EksAA-Aneby	1	G54X	Y
2017-09-25	EksAA-Lonne-Lonne-EksAA	1	G54X	
2017-09-26	OjaAA-VirAA-Lonne-MisAA-MisAA-Lonne-VirAA-OjaAA	1	G54X	
2017-09-27	Savsj-VeiAA-Lahol-Lahol-VeiAA-Savsj	1	G54X	
2017-09-28	KloAA-Uddev-SmoAA-SmoAA-Uddev-KloAA	1	G54X	Y
2017-10-11	LMVAA-Sku1p-Sku1p-LMVAA	1	G54X	Y
2017-10-26	TulAA-Jordb-Jordb-TulAA	1	G54X	
2019-09-18*	Saxna-Steke-Steke-Saxna	1	G54X	Y
2019-09-27*	Ludvi-Lud1p-Lud1p-Ludvi	1	G54X	Y

Note that all the observations with both G54 and G290 on 1987-09-25 and 1993-09-24 were gross errors and removed in the 2019 realization.

Table 24: *The Class A points and their transfer values and their land uplift correction per year used in RG 2000.*

Name	Transfer value from 1.20 to 0.00 m	Correction for the land uplift per year in µGal
Arjeplog AA	410.3	1.3278
Borås AA	343.5	0.5741

Kiruna AA	433.9	1.1335
Kramfors AA	443.8	1.6027
LMV AA	350.6	1.2529
Lycksele AA	397.0	1.6213
Mårtsbo AA	342.7	1.2359
Mårtsbo AB	341.7	1.2359
Onsala AA	394.4	0.4715
Onsala AC	404.2	0.4715
Onsala AN	383.5	0.4715
Onsala AS	383.5	0.4715
Ratan AA	414.9	1.6580
Skellefteå AA	463.8	1.6494
Smögen AA	402.2	0.6134
Visby AA	395.9	0.5194
Östersund AA	420.1	1.3954

Table 25: *Absolute gravity observations included in the 2019 realization of RG 2000. The description of the columns are as follows: A: Name of the point and Time. B: Instrument (FG5). C: g at 1.20 m at measured date. D: Set scatter (µGal). E: Number of drops.F: g at 0.00 m at measured date. G: CRV H: g at measured date after CRV correction. I: g at 0.00 m at epoch 2000.0. J: Operator/s (explanation in Table 26).*

A	B	C	D	E	F	G	H	I	J
Arjeplog AA									
2004,442	220	982253161.80	2.7	2648	982253572.10	2.5	982253569.60	982253575.50	7, 14
2005,671	220	982253160.60	2.1	2696	982253570.90	2.5	982253568.40	982253575.93	6, 1
2006,693	220	982253159.10	2.1	3882	982253569.40	2.5	982253566.90	982253575.79	6, 14
2007,448	220	982253159.30	2	2746	982253569.60	2.5	982253567.10	982253576.99	7, 14
2008,423	220	982253158.40	1.4	1947	982253568.70	2.5	982253566.20	982253577.38	6, 14
2007,611	233	982253159.58	1.5	4287	982253569.88	1	982253568.88	982253578.99	9, 16
2009,584	233	982253154.99	1.27	2397	982253565.29	1	982253564.29	982253577.02	8, 18
2011,783	233	982253159.41	3.28	2341	982253569.71	4.7	982253565.01	982253580.66	1, 13
2013,699	233	982253150.62	1.77	2390	982253560.92	2.2	982253558.72	982253576.91	1, 10
								982253577.24	

								1.65	
Borås AA									
2013,306	233	981679699.76	1.26	1193	981680043.26	2.2	981680041.06	981680048.70	1
2014,434	233	981679698.27	0.89	2392	981680041.77	2.2	981680039.57	981680047.86	1
								981680048.28	
								0.60	
Kiruna AA									
2004,453	220	982336748.50	2.2	2848	982337182.40	2.5	982337179.90	982337184.95	7, 14
2005,659	220	982336748.10	1.6	1998	982337182.00	2.5	982337179.50	982337185.91	6, 1
2006,674	220	982336742.80	2	2339	982337176.70	2.5	982337174.20	982337181.76	6, 14
2007,46	220	982336745.70	2	3097	982337179.60	2.5	982337177.10	982337185.56	7, 14
2007,619	233	982336743.42	1.42	4291	982337177.32	1	982337176.32	982337184.96	9, 16
2008,653005	233	982336742.67	1.42	4291	982337176.57	1	982337175.57	982337185.38	8, 13
2010,611	233	982336744.22	0.75	2296	982337178.12	4.7	982337173.42	982337185.45	1
2012,623	233	982336739.72	1.5	1546	982337173.62	4.7	982337168.92	982337183.23	5, 15
2015,677	233	982336734.66	2.17	2334	982337168.56	2.5	982337166.06	982337183.83	1, 11
								982337184.56	
								1.36	
Kramfors AA									
2004,414	220	982074959.60	2.1	2597	982075403.40	2.5	982075400.90	982075407.97	6, 1
2005,745	220	982074957.70	2.2	3846	982075401.50	2.5	982075399.00	982075408.21	7, 14
2006,734	220	982074955.80	1.7	2740	982075399.60	2.5	982075397.10	982075407.89	7, 14
2007,421	220	982074957.10	2.4	3245	982075400.90	2.5	982075398.40	982075410.29	7, 14
2008,438	220	982074953.60	1.7	4645	982075397.40	2.5	982075394.90	982075408.42	6, 14
2007,741	233	982074955.84	1.56	4276	982075399.64	1	982075398.64	982075411.05	1,
2008,712	233	982074950.99	1.39	2393	982075394.79	1	982075393.79	982075407.75	1, 13
2010,68	233	982074952.11	1.25	2379	982075395.91	4.7	982075391.21	982075408.33	9, 15
2013,708	233	982074943.59	1.81	2391	982075387.39	2.2	982075385.19	982075407.16	1, 10
								982075408.56	
								1.26	
LMV AA									

2007,07	233	981934830.02	2.62	9582	981935180.62	1	981935179.62	981935188.48	1
2007,179	233	981934827.75	1.28	2395	981935178.35	1	981935177.35	981935186.34	9, 1
2007,374	233	981934828.74	1.19	1200	981935179.34	1	981935178.34	981935187.58	1, 16
2007,529	233	981934826.97	0.84	1198	981935177.57	1	981935176.57	981935186.00	1
2007,736	233	981934827.67	1.6	10733	981935178.27	1	981935177.27	981935186.96	5, 9, 1, 8
2007,87	233	981934826.02	0.6	598	981935176.62	1	981935175.62	981935185.48	1, 9, 8, 5, 2
2007,931	233	981934828.65	1.91	1199	981935179.25	1	981935178.25	981935188.19	5
2008,062	233	981934828.16	1.81	2398	981935178.76	1	981935177.76	981935187.86	1,5, 8, 9
2008,152	233	981934827.74	1.73	895	981935178.34	1	981935177.34	981935187.55	1
2008,25	233	981934827.05	1.54	2791	981935177.65	1	981935176.65	981935186.99	1, 8
2008,373	233	981934824.77	2.11	2388	981935175.37	1	981935174.37	981935184.86	5, 8
2008,645	233	981934825.41	5.31	1199	981935176.01	1	981935175.01	981935185.84	5, 8
2008,734	233	981934824.93	1.47	2249	981935175.53	1	981935174.53	981935185.47	1, 13
2009,04	233	981934823.84	3.66	2245	981935174.44	1	981935173.44	981935184.77	8, 1, 5
2009,23	233	981934822.11	1.02	298	981935172.71	1	981935171.71	981935183.27	8,2, 18
2009,296	233	981934826.27	1.6	593	981935176.87	1	981935175.87	981935187.52	8, 9
2009,446	233	981934825.71	0.63	599	981935176.31	1	981935175.31	981935187.14	9
2009,62	233	981934821.80	1.16	1191	981935172.40	1	981935171.40	981935183.45	9, 8
2009,706	233	981934822.08	1.09	2393	981935172.68	1	981935171.68	981935183.84	9, 8
2010,269	233	981934830.28	1.14	998	981935180.88	4.7	981935176.18	981935189.05	8, 11
2010,33	233	981934830.10	1.57	2395	981935180.70	4.7	981935176.00	981935188.94	11, 8, 1
2010,46	233	981934828.35	0.69	597	981935178.95	4.7	981935174.25	981935187.36	5
2010,521	233	981934827.34	0.9	1197	981935177.94	4.7	981935173.24	981935186.42	1
2010,654	233	981934825.32	0.61	597	981935175.92	4.7	981935171.22	981935184.57	9
2010,742	233	981934825.89	1.13	1196	981935176.49	4.7	981935171.79	981935185.25	1
2011,069	233	981934824.69	1.16	599	981935175.29	4.7	981935170.59	981935184.46	1
2011,147	233	981934826.53	1.82	600	981935177.13	4.7	981935172.43	981935186.40	1
2011,266	233	981934828.21	2.09	600	981935178.81	4.7	981935174.11	981935188.22	11, 1
2011,341	233	981934824.40	1.38	2394	981935175.00	4.7	981935170.30	981935184.51	1
2011,627	233	981934825.92	1.11	1197	981935176.52	4.7	981935171.82	981935186.39	11, 12
2011,723	233	981934824.12	1.68	600	981935174.72	4.7	981935170.02	981935184.71	1, 13
2011,82	233	981934826.21	0.54	598	981935176.81	4.7	981935172.11	981935186.92	1
2012,927	233	981934821.91	1.55	1200	981935172.51	2.2	981935170.31	981935186.51	1

2013,024	233	981934823.70	1.36	1195	981935174.30	2.2	981935172.10	981935188.42	1
2013,122	233	981934824.02	2.01	1195	981935174.62	2.2	981935172.42	981935188.86	1
2013,222	233	981934822.79	1.99	1195	981935173.39	2.2	981935171.19	981935187.76	1
2013,278	233	981934823.79	1.37	1195	981935174.39	2.2	981935172.19	981935188.83	1
2013,615	233	981934822.53	0.55	596	981935173.13	2.2	981935170.93	981935187.99	9
2014,117	233	981934822.74	2.18	897	981935173.34	2.2	981935171.14	981935188.83	11, 10
2014,274	233	981934821.15	0.99	1198	981935171.75	2.2	981935169.55	981935187.43	1
2014,374	233	981934820.23	1.39	1198	981935170.83	2.2	981935168.63	981935186.64	1
2015,393	233	981934818.24	1.65	5925	981935168.84	2.5	981935166.34	981935185.63	1
2015,803	233	981934812.30	2.62	3581	981935162.90	2.5	981935160.40	981935180.20	5
2015,92	233	981934818.54	2.78	3574	981935169.14	2.5	981935166.64	981935186.59	1
2016,049	233	981934815.02	1.82	1190	981935165.62	2.5	981935163.12	981935183.23	1
2016,096	233	981934815.64	1.78	2319	981935166.24	2.5	981935163.74	981935183.91	1
2016,134	233	981934815.81	1.85	2363	981935166.41	2.5	981935163.91	981935184.12	1
2016,153	233	981934818.15	1.15	2359	981935168.75	2.5	981935166.25	981935186.49	1
2016,353	233	981934817.03	1.21	1177	981935167.63	2.5	981935165.13	981935185.62	1
2016,356	233	981934817.86	0.96	593	981935168.46	2.5	981935165.96	981935186.45	1
								981935186.29	
								1.85	
Lycksele AA									
2007,732	233	982196333.88	1.81	3439	982196730.88	1	982196729.88	982196742.42	1, 8
2008,417	233	982196332.05	1.19	2380	982196729.05	1	982196728.05	982196741.70	5, 8
2009,636	233	982196329.01	1.49	2386	982196726.01	1	982196725.01	982196740.63	8, 13
2010,6	233	982196334.20	1.07	1835	982196731.20	4.7	982196726.50	982196743.69	11, 17
2012,611	233	982196326.77	2.14	2342	982196723.77	4.7	982196719.07	982196739.52	1, 13
2015,716	233	982196319.97	1.71	2348	982196716.97	2.5	982196714.47	982196739.95	1, 12
								982196741.32	
								1.58	
Mårtsbo AA									
2004,389	220	981923089.30	2	3396	981923432.00	2.5	981923429.50	981923434.92	6, 1
2005,721	220	981923087.10	2.4	3246	981923429.80	2.5	981923427.30	981923434.37	7, 14

2006,748	220	981923086.50	2.1	2747	981923429.20	2.5	981923426.70	981923435.04	7, 14
2007,41	220	981923087.10	1.4	3097	981923429.80	2.5	981923427.30	981923436.46	6
2008,595	220	981923082.70	1.7	3245	981923425.40	2.5	981923422.90	981923433.52	6, 14
2006,948	233	981923087.39	2.53	14363	981923430.09	1	981923429.09	981923437.68	1
2007,037	233	981923090.50	2.87	9583	981923433.20	1	981923432.20	981923440.90	1
2007,413	233	981923085.69	1.05	1891	981923428.39	1	981923427.39	981923436.55	9
2008,295	233	981923084.86	2.03	2243	981923427.56	1	981923426.56	981923436.81	9, 13
2008,675	233	981923082.33	2.9	2150	981923425.03	1	981923424.03	981923434.75	8, 1
2009,096	233	981923082.36	1.49	2388	981923425.06	1	981923424.06	981923435.30	8, 11
2009,325	233	981923083.03	1.97	2390	981923425.73	1	981923424.73	981923436.25	1, 18
2009,899	233	981923083.14	2.7	2296	981923425.84	1	981923424.84	981923437.07	1, 17
2010,039	233	981923080.56	1.27	1249	981923423.26	4.7	981923418.56	981923430.97	8, 11
2010,478	233	981923086.37	1.07	2394	981923429.07	4.7	981923424.37	981923437.32	11, 17
2011,4	233	981923083.61	1.86	2393	981923426.31	4.7	981923421.61	981923435.70	11, 15
2011,908	233	981923083.95	5.92	4844	981923426.65	4.7	981923421.95	981923436.67	1
2012,069	233	981923084.21	2.57	1194	981923426.91	4.7	981923422.21	981923437.13	9
2012,283	233	981923080.48	2.06	531	981923423.18	4.7	981923418.48	981923433.66	1
2012,367	233	981923084.79	2.9	3495	981923427.49	4.7	981923422.79	981923438.07	1
2012,661	233	981923081.11	2.09	2143	981923423.81	4.7	981923419.11	981923434.76	11, 15
2013,373	233	981923082.46	2.51	8512	981923425.16	2.2	981923422.96	981923439.49	1
2014,217	233	981923079.67	3.82	2348	981923422.37	2.2	981923420.17	981923437.74	11, 10
2015,305	233	981923079.47	1.68	5210	981923422.17	2.5	981923419.67	981923438.59	1, 10, 11
2016,203	233	981923074.69	1.44	4724	981923417.39	2.5	981923414.89	981923434.92	1, 10
								981923436.19	
								2.09	
Mårtsbo AB									
2007,41	220	981923094.30	2.2	1450	981923436.00	2.5	981923433.50	981923442.66	6
2007,413	233	981923092.31	1.05	3392	981923434.01	1	981923433.01	981923442.17	9
2012,373	233	981923091.75	3.11	4692	981923433.45	4.7	981923428.75	981923444.04	1
2012,579	233	981923089.68	1.91	1798	981923431.38	4.7	981923426.68	981923442.23	1
2013,375	233	981923083.85	1.5	4433	981923425.55	2.2	981923423.35	981923439.88	1
2013,485	233	981923088.01	1.03	1199	981923429.71	2.2	981923427.51	981923444.18	1

2015,314	233	981923083.49	2.77	4488	981923425.19	2.5	981923422.69	981923441.62	1, 10
2016,214	233	981923080.11	1.73	4726	981923421.81	2.5	981923419.31	981923439.35	1
								981923442.01	
								1.74	
Onsala AA									
2004,816	220	981715897.70	1.8	5780	981716292.10	2.5	981716289.60	981716291.87	7, 14
2005,773	220	981715897.50	3	4939	981716291.90	2.5	981716289.40	981716292.12	7, 14
2006,764	220	981715899.90	2.3	4400	981716294.30	2.5	981716291.80	981716294.99	7, 14
2007,353	220	981715901.70	1.7	2493	981716296.10	2.5	981716293.60	981716297.07	6
2008,633	220	981715897.60	2.2	4635	981716292.00	2.5	981716289.50	981716293.57	6, 14
2009,836	220	981715897.00	2.4	7707	981716291.40	1.7	981716289.70	981716294.34	6
2010,3	220	981715896.70	2.8	2791	981716291.10	1.8	981716289.30	981716294.16	6
2010,304	220	981715896.90	2.2	2938	981716291.30	1.8	981716289.50	981716294.36	6
2011,449	220	981715895.00	1.9	14535	981716289.40	1.8	981716287.60	981716293.00	6
2011,463	220	981715896.10	2.3	2400	981716290.50	1.8	981716288.70	981716294.11	6
2014,408	X220	981715896.40	1.3	2379	981716290.80	2.3	981716288.50	981716295.29	6, 14
2015,112	X220	981715896.90	1.8	4784	981716291.30	2.3	981716289.00	981716296.13	6, 14
2009,509	233	981715897.30	1.46	2115	981716291.70	1	981716290.70	981716295.18	5
2010,496	233	981715900.59	1.35	3836	981716294.99	4.7	981716290.29	981716295.24	5
2011,5	233	981715900.77	2.42	2376	981716295.17	4.7	981716290.47	981716295.89	1
2013,319	233	981715898.92	1.51	11945	981716293.32	2.2	981716291.12	981716297.40	1
2014,417	233	981715895.11	2.4	14242	981716289.51	2.2	981716287.31	981716294.11	1
2015,353	233	981715897.02	1.69	9050	981716291.42	2.5	981716288.92	981716296.16	1
2016,499	233	981715895.41	1.2	33723	981716289.81	2.5	981716287.31	981716295.09	1
								981716294.74	
								1.48	
Onsala AC									
2014,411	X220	981715903.70	1.5	2191	981716307.90	2.3	981716305.60	981716312.40	6, 14
2015,099	X220	981715901.60	1.5	5926	981716305.80	2.3	981716303.50	981716310.62	6, 14
2009,507	233	981715903.59	1.19	1415	981716307.79	1	981716306.79	981716311.27	5
2014,411	233	981715900.16	1.43	11391	981716304.36	2.2	981716302.16	981716308.96	1
2015,359	233	981715903.09	4.18	18990	981716307.29	2.5	981716304.79	981716312.03	1
2016,488	233	981715899.43	1.07	18774	981716303.63	2.5	981716301.13	981716308.90	1

								981716310.70	
								1.50	
Onsala AN									
2010,724	233	981716219.30	1.36	1897	981716219.30	4.7	981716214.60	981716219.66	5
2013,334	233	981716214.15	2.12	2399	981716214.15	2.2	981716211.95	981716218.24	1
								981716218.95	
								1.00	
Onsala AS									
2007,226	233	981716221.22	1.76	4788	981716221.22	1	981716220.22	981716223.63	1, 20
2009,503	233	981716220.28	1.79	2392	981716220.28	1	981716219.28	981716223.76	5
2010,503	233	981716224.17	1.1	2392	981716224.17	4.7	981716219.47	981716224.42	5
2010,723	233	981716227.27	0.87	1049	981716227.27	4.7	981716222.57	981716227.63	5
2011,506	233	981716225.50	2.38	2395	981716225.50	4.7	981716220.80	981716226.22	1
2013,339	233	981716221.36	2.02	2388	981716221.36	2.2	981716219.16	981716225.45	1
								981716225.18	
								1.56	
Ratan AA									
2007,636	233	982188574.51	1.27	4726	982188989.41	1	982188988.41	982189001.07	1, 13
2008,666	233	982188569.39	0.92	2394	982188984.29	1	982188983.29	982188997.66	8, 13
2009,644	233	982188569.12	1.24	2488	982188984.02	1	982188983.02	982188999.01	8, 13
2010,591	233	982188572.60	1.32	2395	982188987.50	4.7	982188982.80	982189000.36	11, 17
2012,602	233	982188565.94	1.82	2396	982188980.84	4.7	982188976.14	982188997.03	1, 13
2015,669	233	982188558.76	1.58	2339	982188973.66	2.5	982188971.16	982188997.14	1, 11
								982188998.71	
								1.72	
Skellefteå AA									
2004,432	220	982229926.20	1.8	5640	982230390.00	2.5	982230387.50	982230394.81	6, 1
2005,732	220	982229926.10	2.2	3296	982230389.90	2.5	982230387.40	982230396.85	7, 14
2006,721	220	982229921.20	2	3083	982230385.00	2.5	982230382.50	982230393.59	7, 14
2007,436	220	982229921.30	2.4	2646	982230385.10	2.5	982230382.60	982230394.87	7, 14
2008,415	220	982229920.70	2.1	3291	982230384.50	2.5	982230382.00	982230395.88	6, 14
2007,628	233	982229922.90	1.37	4533	982230386.70	1	982230385.70	982230398.28	1, 13

2008,409	233	982229921.17	1.12	2525	982230384.97	1	982230383.97	982230397.84	5, 8
2010,619	233	982229919.07	1.02	2244	982230382.87	4.7	982230378.17	982230395.69	1, 5
2012,63	233	982229914.19	1.64	2385	982230377.99	4.7	982230373.29	982230394.12	5, 15
2015,708	233	982229905.96	1.44	2348	982230369.76	2.5	982230367.26	982230393.17	1, 12
								982230395.51	
								1.74	
Smögen AA									
2008,78	233	981769786.77	3.69	2394	981770188.97	1	981770187.97	981770193.36	1, 8
2009,398	233	981769784.53	1.77	2392	981770186.73	1	981770185.73	981770191.49	8, 13
2010,384	233	981769789.64	1.2	2689	981770191.84	4.7	981770187.14	981770193.51	8, 9
2012,328	233	981769784.06	3.22	2396	981770186.26	4.7	981770181.56	981770189.12	1, 12
2013,439	233	981769783.43	1.41	2390	981770185.63	2.2	981770183.43	981770191.67	1, 11
								981770191.83*	
								1.78*	
Visby AA									
2004,399	220	981714000.80	1.9	2597	981714396.70	2.5	981714394.20	981714396.48	6, 1
2005,759	220	981713997.50	2.3	3094	981714393.40	2.5	981714390.90	981714393.89	7, 14
2007,395	233	981713999.16	2.14	4639	981714395.06	1	981714394.06	981714397.90	1, 5
2009,387	233	981713994.91	2.02	2695	981714390.81	1	981714389.81	981714394.69	8, 17
2011,744	233	981713998.30	2.39	2398	981714394.20	4.7	981714389.50	981714395.60	1
2013,45	233	981713996.18	1.75	2378	981714392.08	2.2	981714389.88	981714396.87	1, 11
								981714395.90	
								1.48	
Östersund AA									
2004,423	220	982044623.30	2.1	3496	982045043.40	2.5	982045040.90	982045047.07	6, 1
2005,685	220	982044622.70	1.9	3598	982045042.80	2.5	982045040.30	982045048.23	6, 1
2006,708	220	982044620.50	1.8	2535	982045040.60	2.5	982045038.10	982045047.46	6, 7
2007,393	220	982044624.20	2.3	2197	982045044.30	2.5	982045041.80	982045052.12	6
2008,605	220	982044615.40	1.7	2598	982045035.50	2.5	982045033.00	982045045.01	6, 14
2007,644	233	982044618.77	0.99	4795	982045038.87	1	982045037.87	982045048.54	1, 19
2008,705	233	982044616.50	1.21	2397	982045036.60	1	982045035.60	982045047.75	1

2009,577	233	982044614.08	1.1	3396	982045034.18	1	982045033.18	982045046.54	8, 18
2011,674	233	982044617.96	2.28	2078	982045038.06	4.7	982045033.36	982045049.65	1, 12
2015,724	233	982044609.26	1.31	2349	982045029.36	2.5	982045026.86	982045048.80	1, 12
								982045048.12	
								1.91	

Table 26: *List of operators, RG and AG (see column D in Table 23 and column J in Table 25)*

1	Andreas Engfeldt
2	Lars Åke Haller
3	Lennart Pettersson
4	Håkan Skatt
5	Per-Anders Olsson
6	Ludger Timmen
7	Olga Gitlein
8	Geza Lohasz
9	Jonas Ågren
10	Holger Steffen
11	Fredrik Dahlström
12	Jakob Jansson
13	Unspecified from Lantmäteriet
14	Unspecified from IfE
15	Linda Ahlm
16	Runar Svensson
17	Robert Odolinski
18	Johan Sunna
19	Martin Lidberg
20	Mikael Lilje

Table 27: *Observations and orientations of the Lantmäteriet gravimeter FG5-233 (*comparison, ** the marks by IfE were used and inside the building the compass showed the wrong direction, *** not used in the first realization of RG 2000), LMV AA excluded due to too many observations.*

Point	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Arjeplog AA	N, S	-	N, S	-	N, S	-	N, S	-	-	-
Borås AA	-	-	-	-	-	-	N-30, S-30	N, S	-	-
Kiruna AA	N, S	N, S***	-	N, S	-	N, S	-	-	N, S	-
Kramfors AA	S, N	S, N	-	N, S	-	-	N, S	-	-	-
Lycksele AA	N, S	N, S	N, S	N, S	-	N, S	-	-	N, S	-
Mårtsbo AA	S, N*, N	N, S, N, S	N, S, N, S, N, S	S, N, S	N, S, N, S	S, N*, S*, N, S	N*, S*	?	N, S	N, S
Mårtsbo AB	N*, S*	-	-	-	-	S*, N*	S*, N*	-	N, S	N, S
Onsala AA	-	-	N, S	S	N, S	-	S, N	S*, N*	S, N	S, N
Onsala AC	-	-	N, S	-	-	-	-	N*, S*	N, S	N, S
Onsala AN	-	-	-	S*, N*	-	-	S, N	-	-	-
Onsala AS	S, N	-	S, N	S*, N*	N, S	-	N, S	-	-	-
Ratan AA	N, S	N, S	N, S	N, S	-	N, S	-	-	N, S	-
Skellefteå AA	S, N	S, N	-	N, S	-	N, S	-	-	N, S	-
Smögen AA	-	N, S	N, S	N, S	-	N, S	N, S	-	N, S	-
Visby AA	N, S	-	N, S	-	N, S	-	N, S	-	-	-
Östersund AA	N, S	S, N	N, S	-	N, S	-	-	-	N, S	-

Table 28: *Observations and orientations of the IfE gravimeter FG5-220 (*comparison, ** compass showed wrong, *** not used in RG 2000)*

Site	2003	2004	2005	2006	2007	2008
Arjeplog AA	?***	?	S, N	S, N	S, N	S, N
Borås AA	?***	-	-	-	-	N-30, S-30 **
Kiruna AA	-	S, “new setup with half superspring feet rotated”	S, N+10 (pillar not even)	S, N+15	S, N+15	-
Kramfors AA	S***	S, S	S, S, N	S, N	S, N, S	S, S, N, S
Mårtsbo AB	-	-	-	-	N *	-
Mårtsbo AA	-	N, S	S (probably), S, N	S, N, S	N*, S*, N*	N, S
Onsala AN	-	S* (probably)	S*	S, N	S	N, S
Onsala AS	?***	S* (probably)	S* (comparison)	S, N	S, N	S, N, S
Skellefteå AA	?***	S, S-10, S	S, N	S, S, N	S, N	S, N, S
Visby AA	-	N, N+20, N+20	N, N+20, S	-	-	-
Östersund AA	?***	N, N+10 (hard to operate from S)	N, N+15 (hard to operate from S)	N, N+15 (hard to operate from S)	N, N+15 (hard to operate from S)	N, N+15 (hard to operate from S)

Table 29: *The points in RG 2000 which have spare points.*

Area	Main point	Spare point(s) in order
Arjeplog N (Hällnäs)	Arjeplog AA	Arjeplog B
Arjeplog village	Arjeplog AB	Arjeplog
Arvidsjaur	Arvidsjaur AA	1 Arvidsjaur 1p 2 Arvidsjaur
Avesta	Grytnäs AA	Avesta
Björkliden	Björkliden NB	Björkliden NA

Borgholm	Köpingsvik AA	Borgholm
Borlänge	Borlänge	Stora Tuna 1p
Borås	Borås AA	1 Borås 2 Borås 1p
Enköping	Svinnegarn AA	Enköping
Föllinge	Föllinge A	Föllinge B
Gällivare	Gällivare AA	Gällivare
Gävle	LMV AA	LM Pol 7
Göteborg	Göteborg NB	1 Göteborg 1p 2 Göteborg AA
Hammerdal / Strömsund	Hammerdal AA	1 Hallviken 2 Ström 1p
Haparanda	Haparanda AA	Haparanda
Hede	Hede AA	Hede
Häggenås	Östersund AA	Östersund B
Hörnefors	Hörnefors AA	Hörnefors 1p
Höör	Höör AA	1 Höör B 2 Höör A
Jokkmokk	Jokkmokk	Jokkmokk 1p
Jukkasjärvi	Jukkasjärvi NA	Jukkasjärvi NB
Jävre	Jävre NA	Jävre NB
Karesuando	Karesuando AA	Karesuando
Karlskrona	Augerum AA	1 Johannishus 2 Jämjö 1p
Karlstad	Karlstad AA	Karlstad NA
Kramfors	Kramfors AA	1 Kramfors AB 2 Kramfors C 3 Kramfors A 4 Kramfors B
Kvikkjokk	Kvikkjokk NB	Kvikkjokk NA
Kåbdalis	Kåbdalis AA	1 Kåbdalis NB 2 Kåbdalis 1p
Laholm	Veinge AA	Laholm

Lindesberg	Lindesberg	Lindesberg 1p
Ljusdal	Ljusdal AA	Hybo
Ludvika	Ludvika	Ludvika 1p
Luleå	Luleå AA	Bergnäset
Lycksele	Lycksele AA	1 Lycksele D 2 Lycksele A 3 Lycksele C
Malung	Malung	Malung 1p
Mårtsbo	Mårtsbo AA	1 Mårtsbo AB 2 Mårtsbo B
Norrtälje	Norrtälje AA	Norrtälje
Norsjö	Norsjö AA	Norsjö
Onsala	Onsala AA	1 Onsala AC 2 Onsala AS 3 Onsala AN 4 Onsala B 5 Onsala A
Pajala	Pajala	Pajala 1p
Pello	Pello NA	1 Pello NB 2 Pello 1p
Ratan/Sävar	Ratan AA	1 Ratan B 2 Sävar AA 3 Sävar B
Skellefteå N	Skellefteå AA	1 Skellefteå B 2 Lidträsk
Skellefteå S / Bureå	Bureå AA	1 Bureå 1p 2 Lövånger 3 Nysätra 1p
Sollefteå	Sollefteå AA	Sollefteå
Sorsele	Sorsele AA	Sorsele
Storuman/Stensele	Stensele AA	1 Stensele B 2 Stensele B 1p 3 Stensele A

Stockholm N	Solna AA	Solna
Stockholm S	Tullinge AA	1 Södertälje NA 2 Jordbro 3 Södertälje NB 4 Turinge 1p
Stugun	Stugun AA	1 Stugun B 2 Stugun A 3 Stugun C 4 Stugun D
Stöllet	Stöllet AA	Norra Ny 1p
Sundsvall	Sundsvall AA	1 Sundsvall 1p 2 Stavreviken
Sveg	Sveg AA	Sveg
Särna	Särna AA	1 Särna 1p 2 Särna
Söderhamn	Vallvik	Söderhamn 1p
Sölvesborg	Sölvesborg AA	1 Sölvesborg A 2 Sölvesborg B
Tanum	Tanum AA	Tanum
Transtrand / Sälen	Transtrand AA	Transtrand
Umbukta	Umbukta AA	1 Umbukta A 2 Umbukta B
Uppsala	Uppsala	Uppsala C 1p
Vilhelmina	Vilhelmina AA	Vilhelmina
Virserum / Åseda	Virserum AA	Åseda
Visby	Visby AA	1 Visby D 2 Visby NA 3 Visby NB
Vittangi	Vittangi	1 Vittangi 1p 2 Vittangi 2p
Voxna/Voxna bruk	Voxna AA	Voxna
Västervik/Gamleby	Gamleby AA	1 Västervik NA 2 Västervik NB

Växjö	Öjaby AA	Ör
Åsele	Åsele AA	Åsele
Älmhult / Osby	Älmhult AA	1 Osby 2 Stenbrohult 1p
Älvdalen	Älvdalen AA	1 Älvdalen A 2 Älvdalen B
Älvsbyn	Älvsbyn AA	Älvsbyn
Ödeshög	Västra Tollstad AA	1 Ödeshög NA 2 Ödeshög NB
Örebro	Örebro	Örebro 1p
Örnsköldsvik	Örnsköldsvik AA	1 Örnsköldsvik 1p 2 Åte
Östhammar/Öregrund	Öregrund AA	1 Östhammar A 2 Östhammar B
Övertorneå	Övertorneå AA	Övertorneå 1p

Table 30: *The base points from 1943-1948. The first 17 were observed in 1943-1944, the last 18 were observed in 1945-1948.*

Name	g-value (mGal)	Name in RG 62
Eskilstuna (Nr 4)	981851.9	Perhaps Eskilstuna Klosters church = Eskilstuna 1p
Falköping (Nr 85, the church)	981716.3	-
Kalmar (Nr 566a)	981664.6	-
Karlstad (Nr 38)	981844.1	Perhaps Karlstad cathedral = Karlstad A 1p
Linköping (Nr 82)	981778.5	-
Nässjö I (Nr 81)	981682.1	-
Nässjö II	981684.3	-
Stockholm	981846.7	RAK 02 1p
Stöllet	981858.6	Perhaps Norra Ny 1p
Säter (Nr 681a, the church)	981899.8	-
Uddevalla (Nr 146, the	981782.2	-

church)		
Uppsala (Nr 2)	981900.0	Most likely Uppsala A 1p, otherwise Uppsala B 1p
Varberg (Nr 117)	981709.4	Varberg Apelviksåsen A
Vimmerby (Nr 525)	981714.5	-
Vislanda (Nr N 121)	981610.4	Vislanda 1p
Årjäng (Nr 246)	981829.8	-
Örebro (Nr 83)	981835.5	Örebro 1p
Arvidsjaur	982232.4	-
Bastuträsk (Nr 811)	982208.7	-
Bollnäs (Nr 767)	982003.8	Bollnäs Åsen 1p
Gällivare (Nr 1590, the church)	982356.5	Gällivare AA
Hoting (Nr 1247)	982152.0	-
Kiruna (Nr 1632, the church)	982330.4	Kiruna A 1p
Luleå (Nr 1440, the cathedral)	982310.4	Luleå AA
Mora I (the church)	981936.9	-
Mora II (Nr 805)	981934.9	-
Sollefteå (Nr 1451, the church)	982138.9	Sollefteå AA
Storuman	982183.1	-
Sundsvall (Nr 808)	982060.8	Perhaps Sundsvall N Stadsberget 1p
Sveg (Nr 809, the church)	981983.1	-
Särna (Nr 929, the new church)	981921.6	Särna 1p
Visby	981734.7	-
Vännäs (Nr 810, the church)	982200.4	-
Ånge (Nr 804)	982061.8	-
Östersund (Nr 807)	982059.8	Östersund AB

Table 31: *Coordinates of the Class D points included in the FAMOS project. All latitudes and longitudes are measured with RTK Fix except indicated * with Static GNSS. All heights are measured with RTK Fix, except the points which are benchmarks (levelled) and indicated * with Static GNSS and ** as estimated.*

Name	Lat	Long	Height
Ystad, The Theatre	55 25 39.70	13 49 07.26	2.733
Ystad, St Maria church	55 25 45.38	13 49 06.98	8.224
Åhus, St Maria church	55 55 24.25	14 17 35.00	5.073
Åhus, Benchmark 34-0009	55 55 16.22	14 17 05.03	4.744
Karlshamn, Carl Gustaf church	56 10 16.44	14 51 44.08	8.850
Karlshamn, Benchmark 34-5708	56 10 55.72	14 49 44.58	32.990
Ronneby, Benchmark 7355390*	56 10 35.46	15 17 59.68	2.767
Ronneby, Benchmark 35-6413	56 11 51.90	15 19 37.81	16.417
Karlskrona, The Fredrik church	56 09 40.48	15 35 18.03	16.288
Karlskrona, Benchmark 35-3818	56 11 43.47	15 40 08.41	28.477
Kalmar, Tullhuset	56 39 47.79	16 22 07.70	2.955
Kalmar, Cathedral	56 39 51.65	16 21 56.09	4.542
Oxelösund, Benchmark 97-1502	58 39 51.49	17 07 39.54	14.903
Oxelösund, Benchmark 97-1504	58 40 02.57	17 07 08.52	9.302
Stockholm, Benchmark 108-6527	59 19 27.55	18 04 55.75	3.216
Stockholm, Benchmark SS301025**	59 19 23.72	18 06 06.91	5.000
Ljusne, Benchmark 147-7415	61 12 53.70	17 07 33.77	20.972
Ljusne, Tele**	61 12 48.20	17 08 04.42	5.000
Skelleftehamn, Benchmark 2217190*	64 41 45.83	21 12 37.57	35.700
Skelleftehamn, St Örjan church	64 41 23.96	21 14 26.54	13.660

Table 32: *The difference between RG 2000 and RG 82 for the 200 points included in RG 82 which has g-values also in RG 2000. Note that the land uplift is included in the difference between the systems. Note that the points also included in RG 62 measured almost the same way as the new RG 82 points never were "real RG 82 points" and therefore are not included here. Column A: Storruta (Map index); Column B: Name; Column C: RG 2000 (2019 realization, in mGal); Column D: RG 82 (in mGal); Column E: Difference RG 2000 – RG 82 (in mGal).*

A	B	C	D	E
2C	Dalby	981565,6630	981565,696	-0,0330
2E	Simrishamn AA	981566,9721	981566,983	-0,0109
3C	Åstorp	981617,3635	981617,389	-0,0255
3D	Höör A	981580,4164	981580,437	-0,0206
3D	Höör B	981580,4149	981580,438	-0,0231
3E	Sölvesborg A	981580,4148	981580,437	-0,0222
3E	Sölvesborg B	981580,4199	981580,443	-0,0231
3F	Johannishus	981612,1312	981612,156	-0,0248
4C	Laholm	981652,9954	981653,010	-0,0146
4D	Osby	981589,5336	981589,559	-0,0254
4E	Urshult	981594,5976	981594,626	-0,0284
4F	Emmaboda AA	981630,1414	981630,169	-0,0276
4G	Torsås	981641,3444	981641,380	-0,0356
4H	Kastlösa	981624,3996	981624,427	-0,0274
5C	Torup	981676,6156	981676,644	-0,0284
5D	Lagan	981612,4497	981612,487	-0,0373
5E	Ör	981619,2691	981619,310	-0,0409
5F	Åseda	981638,7306	981638,771	-0,0404
5G	Blomstermåla	981658,9396	981658,987	-0,0474
5H	Borgholm	981650,5050	981650,542	-0,0370
5J	Grötlingbo	981654,4228	981654,450	-0,0272
6B	Veddige	981696,0552	981696,092	-0,0368
6C	Svenljunga	981666,0451	981666,080	-0,0349
6D	Hillerstorp	981643,2387	981643,279	-0,0403
6E	Sävsjö	981655,0650	981655,112	-0,0470
6F	Lönneberga	981680,7687	981680,827	-0,0583

6G	Misterhult AA	981682,8746	981682,922	-0,0474
6I	Visby NA	981719,2348	981719,266	-0,0312
6I	Visby NB	981718,5397	981718,567	-0,0273
6J	Garde	981695,0769	981695,104	-0,0271
6J	Gothem	981713,3499	981713,380	-0,0301
7B	Göteborg AA	981718,7069	981718,749	-0,0421
7B	Göteborg NB	981718,3356	981718,370	-0,0344
7C	Borås	981661,2951	981661,340	-0,0449
7D	Bottnaryd	981671,5896	981671,655	-0,0654
7E	Aneby	981669,6328	981669,676	-0,0432
7F	Kisa	981720,3710	981720,426	-0,0550
7G	Västervik NA	981718,5402	981718,574	-0,0338
7G	Västervik NB	981718,4177	981718,453	-0,0353
7J	Bunge	981699,5470	981699,582	-0,0350
8B	Uddevalla	981760,2052	981760,238	-0,0328
8C	Vara AA	981752,3302	981752,395	-0,0648
8D	Dala	981719,7288	981719,773	-0,0442
8E	Ödeshög NA	981718,3848	981718,430	-0,0452
8E	Ödeshög NB	981718,4279	981718,473	-0,0451
8F	Motala	981760,2701	981760,343	-0,0729
8G	Norrköping AA	981789,0414	981789,066	-0,0246
8G	Åtvidaberg	981736,7548	981736,805	-0,0502
8J	Gotska sandön	981746,1876	981746,220	-0,0324
9A	Tanum	981786,1517	981786,195	-0,0433
9B	Dals Ed	981775,9000	981775,957	-0,0570
9D	Mariestad AA	981774,0185	981774,076	-0,0575
9E	Laxå AA	981787,1001	981787,151	-0,0509
9F	Ljusfallshammar AA	981785,3030	981785,362	-0,0590
9G	Valla AA	981816,5343	981816,565	-0,0307
9H	Nyköping AA	981801,2021	981801,229	-0,0269
10B	Årjäng AA	981819,3803	981819,424	-0,0437
10C	Säffle AA	981817,0547	981817,088	-0,0333
10D	Karlstad NA	981828,1083	981828,158	-0,0497

10E	Bofors	981804,5696	981804,614	-0,0444
10F	Örebro	981816,7046	981816,750	-0,0454
10G	Eskilstuna	981833,4369	981833,477	-0,0401
10H	Södertälje NA	981828,0847	981828,128	-0,0433
10H	Södertälje NB	981827,9854	981828,024	-0,0386
10I	Jordbro	981822,8467	981822,885	-0,0383
10I	Solna	981829,1070	981829,155	-0,0480
11C	Arvika	981844,4384	981844,497	-0,0586
11D	Munkfors AA	981826,7445	981826,788	-0,0435
11E	Grythyttan	981819,9012	981819,955	-0,0538
11F	Lindesberg	981835,2938	981835,343	-0,0492
11G	Hallstahammar	981838,5543	981838,612	-0,0577
11H	Enköping	981856,0478	981856,085	-0,0372
11I	Uppsala	981883,6616	981883,699	-0,0374
11J	Norrtälje	981857,3908	981857,437	-0,0462
12C	Torsby	981856,1275	981856,177	-0,0495
12D	Ekshärad	981828,0033	981828,050	-0,0467
12E	Fredriksberg AA	981841,5967	981841,665	-0,0683
12F	Ludvika	981867,3896	981867,441	-0,0514
12G	Avesta	981882,6759	981882,716	-0,0401
12H	Tärnsjö	981900,8304	981900,879	-0,0486
12I	Östhammar A	981908,1628	981908,210	-0,0472
12I	Östhammar B	981908,1570	981908,206	-0,0490
13C	Sysslebäck	981864,0487	981864,112	-0,0633
13D	Stöllet AA	981819,8786	981819,943	-0,0644
13D	Malung	981840,6592	981840,702	-0,0428
13E	Vansbro AA	981861,8193	981861,844	-0,0247
13F	Borlänge	981907,8745	981907,934	-0,0595
13G	Hofors A	981908,1613	981908,210	-0,0487
13G	Hofors B	981908,1730	981908,224	-0,0510
13H	Mårtsbo AA	981923,4355	981923,484	-0,0485
13H	Mårtsbo B	981923,5969	981923,646	-0,0491
14D	Transtrand	981865,6817	981865,727	-0,0453

14E	Mora	981926,1518	981926,203	-0,0512
14F	Rättvik	981923,1949	981923,248	-0,0531
14G	Åmot	981935,3154	981935,356	-0,0406
14H	Vallvik	981987,8364	981987,890	-0,0536
15D	Särna	981897,1198	981897,162	-0,0422
15E	Älvdalen A	981908,1486	981908,201	-0,0524
15E	Älvdalen B	981908,1503	981908,200	-0,0497
15E	Tandsjöborg	981916,2386	981916,293	-0,0544
15F	Voxna	981967,4455	981967,513	-0,0675
15G	Arbrå	981992,3716	981992,413	-0,0414
15H	Boda bruk AA	981998,3268	981998,390	-0,0632
16C	Idre	981885,2978	981885,374	-0,0762
16D	Lofsdalen	981893,7447	981893,790	-0,0453
16E	Sveg	981957,8940	981957,940	-0,0460
16F	Laforsen	982011,0248	982011,074	-0,0492
16G	Hybo	982020,3657	982020,411	-0,0453
16H	Gnarp	982030,2486	982030,299	-0,0504
17C	Tännäs	981907,1981	981907,262	-0,0639
17D	Hede	981948,3203	981948,373	-0,0527
17E	Rätansbyn	982013,4732	982013,541	-0,0678
17F	Alby	982038,9379	982039,002	-0,0641
17G	Torpshammar	982068,4823	982068,551	-0,0687
17H	Stavreviken	982082,3273	982082,376	-0,0487
18E	Svenstavik AA	982030,8042	982030,860	-0,0558
18F	Stavre	982038,9967	982039,059	-0,0623
18G	Boda	982087,9303	982087,991	-0,0607
18I	Kramfors A	982076,5821	982076,644	-0,0619
18I	Kramfors B	982077,0361	982077,100	-0,0639
18I	Kramfors C	982075,5143	982075,573	-0,0587
18I	Kramfors AB	982075,7225	982075,783	-0,0605
19C	Ånn	981998,5916	981998,659	-0,0674
19D	Järpen	982027,9634	982028,002	-0,0386
19E	Krokom	982048,4801	982048,528	-0,0479

19F	Stugun A	982076,4158	982076,474	-0,0582
19F	Stugun B	982075,6696	982075,728	-0,0584
19F	Stugun C	982075,6080	982075,670	-0,0620
19F	Stugun D	982075,8874	982075,942	-0,0546
19G	Ramsele	982129,9128	982129,966	-0,0532
19H	Sollefteå	982115,6375	982115,690	-0,0525
19I	Åte	982122,3313	982122,395	-0,0637
20E	Föllinge A	982075,7178	982075,771	-0,0532
20E	Föllinge B	982075,6892	982075,738	-0,0488
20F	Hallviken	982108,1892	982108,242	-0,0528
20H	Gulsele	982138,1203	982138,176	-0,0557
20I	Björna	982143,3118	982143,374	-0,0622
20J	Bjurholm AA	982148,0464	982148,102	-0,0556
20K	Hörnefors AA	982150,8465	982150,903	-0,0565
21F	Sved AA	982086,2416	982086,297	-0,0554
21G	Hoting	982143,6269	982143,693	-0,0661
21H	Åsele	982139,8243	982139,883	-0,0587
21I	Fredrika	982152,2462	982152,311	-0,0648
21J	Hällnäs	982165,3851	982165,441	-0,0559
21K	Sävar AA	982191,0301	982191,088	-0,0579
21K	Sävar B	982191,0052	982191,060	-0,0548
22E	Gäddede	982122,7506	982122,804	-0,0534
22G	Vilhelmina	982144,0586	982144,115	-0,0564
22H	Vinliden	982151,7108	982151,769	-0,0582
22I	Lycksele A	982191,0657	982191,124	-0,0583
22K	Burträsk	982206,1271	982206,184	-0,0569
22L	Lövånger	982223,1986	982223,260	-0,0614
23E	Stekenjokk	982065,2827	982065,366	-0,0833
23F	Saxnäs	982093,8243	982093,903	-0,0787
23G	Strömsund	982178,1062	982178,148	-0,0418
23H	Stensele A	982191,1285	982191,189	-0,0605
23H	Stensele B	982191,1962	982191,251	-0,0548
23I	Malå	982217,3571	982217,407	-0,0499

23J	Norsjö	982190,2033	982190,257	-0,0537
23K	Lidträsk	982203,0628	982203,153	-0,0902
23L	Jävre NA	982269,2836	982269,347	-0,0634
23L	Jävre NB	982268,7586	982268,824	-0,0654
24F	Tärnaby	982153,9043	982153,959	-0,0547
24H	Sorsele	982217,4598	982217,522	-0,0622
24J	Arvidsjaur	982216,6858	982216,748	-0,0622
24K	Älvsbyn	982299,3062	982299,355	-0,0488
24L	Bergnäset	982298,8386	982298,900	-0,0614
25E	Umbukta A	982191,1412	982191,175	-0,0338
25E	Umbukta B	982191,2943	982191,341	-0,0467
25F	Hemavan	982165,8612	982165,914	-0,0528
25G	Ammarnäs	982198,6635	982198,716	-0,0525
25H	Arjeplog	982237,3331	982237,394	-0,0609
25J	Kåbdalis AA	982270,3848	982270,445	-0,0602
25J	Kåbdalis NB	982268,8918	982268,958	-0,0662
25L	Hundsjön AA	982329,5476	982329,626	-0,0784
25M	Kalix	982316,5531	982316,642	-0,0889
25N	Haparanda	982321,2006	982321,264	-0,0634
26H	Jäkkvik	982242,1821	982242,229	-0,0469
26J	Jokkmokk	982347,3358	982347,400	-0,0642
26K	Edefors	982340,0001	982340,067	-0,0669
26L	Lansån	982349,8332	982349,906	-0,0728
26M	Övertorneå AA	982326,8587	982326,908	-0,0493
27H	Kvikkjokk NA	982269,0627	982269,111	-0,0483
27H	Kvikkjokk NB	982268,7201	982268,767	-0,0469
27J	Porjus	982319,7703	982319,832	-0,0617
27L	Hakkas	982356,4407	982356,510	-0,0693
27M	Korpilombolo	982345,5563	982345,628	-0,0717
27N	Pello NA	982362,3950	982362,461	-0,0660
27N	Pello NB	982365,5136	982365,580	-0,0664
28K	Gällivare	982345,2013	982345,267	-0,0657
28L	Junosuando	982397,6044	982397,682	-0,0776

28M	Pajala	982372,8048	982372,864	-0,0592
29J	Jukkasjärvi NA	982361,8541	982361,917	-0,0629
29J	Jukkasjärvi NB	982362,0900	982362,156	-0,0660
29K	Vittangi	982402,8911	982402,958	-0,0669
30I	Björkliden NA	982362,0803	982362,145	-0,0647
30I	Björkliden NB	982365,4843	982365,553	-0,0687
30J	Torneträsk	982378,7120	982378,769	-0,0570
30K	Sopporo	982375,7849	982375,837	-0,0521
31L	Karesuando	982424,9332	982425,006	-0,0728

Appendix 3, Tests of RG 62

During the work with the transformations, RG 62 was investigated and re-calculated in Gad.

In RG 62, only the junction points were part in the network adjustment, which was done in loops where a line in the loop could have between 2 and 9 points. The report *Pettersson (1967)* does unfortunately not exactly describe what was included in the network adjustment. For example, it is mentioned that the loop Kiruna A-Bodø A-Fauske-Narvik-Kiruna A was not included since it was not measured before the network adjustment took place. Since Bodø A was used as an absolute point in the network adjustment, this information is disputable. Note, the point notation with some running digits (e.g., 83 00 0J and 83 00 0K along a loop) can be misleading.

Before the new calculations were done, the 25 loops were checked concerning whether how close to 0 the sum of all gravity differences in the loop was. Note that *Pettersson (1967)* mentions only 24 loops, but when counting them there are 25 loops. We speculate that two of them were not included, probably the second last and third last in Table 33 which contain Bodø A, and that the extra loop in the last row of Table 33 without Bodø A was included instead.

Table 33: *Loops and their misclosure in mGal. Here, the 25 loops are included plus an extra loop, excluding Bodø A.*

Loop	Misclosure (mGal)
RAK02-Tjust-Jönköping-Örebro-RAK02	0.097
RAK02-Uppsala-Arlanda-RAK02	-0.018
RAK02-Örebro-Furudal-Bollnäs-Skutskär-Uppsala-RAK02	-0.215
Tjust-Dörby-Vislanda-Jönköping-Tjust	-0.060
Dörby-Kristianstad-Vislanda-Dörby	0.041
Vislanda-Kristianstad-Bulltofta-Helsingborg-Veinge-Vislanda	0.055
Helsingborg-Bulltofta-København-Helsingborg	-0.117
Jönköping-Vislanda-Veinge-Göteborg-Jönköping	0.063
Örebro-Jönköping-Göteborg-Oslo-Karlstad-Örebro	0.150
Örebro-Karlstad-Särna-Furudal-Örebro	0.160
Bollnäs-Söderhamn-Skutskär-Bollnäs	0.025
Bollnäs-Furudal-Särna-Östersund-Sollefteå-Gudmundrå-Söderhamn-Bollnäs	-0.162
Örnsköldsvik-Gudmundrå-Sollefteå-Örnsköldsvik	-0.009
Örnsköldsvik-Sollefteå-Östersund-Stensele-Sandsele-Bastuträsk-Nysätra-Umeå-Örnsköldsvik	-0.205

Örnsköldsvik-Umeå-Hörnefors-Örnsköldsvik	0.047
Örnsköldsvik-Hörnefors-Koivulahti-Örnsköldsvik	0.032
Nysätra-Bastuträsk-Bureå-Nysätra	0.056
Bureå-Bastuträsk-Sandsele-Gällivare-Morjärv-Bureå	0.072
Gällivare-Svappavaara-Muodoslombolo-Pello-Karungi-Morjärv-Gällivare	-0.046
Karungi-Kemi-Morjärv-Karungi	-0.103
Karlstad-Oslo-Vinstra-Särna-Karlstad	-0.184
Östersund-Särna-Vinstra-Stjördal-Östersund	0.047
Östersund-Stjördal-Mo i Rana-Stensele-Östersund	0.118
Kiruna-Bodø-Fauske-Narvik-Kiruna	0.026
Kiruna-Svappavaara-Gällivare-Sandsele-Stensele-Mo i Rana-Fauske-Bodø-Kiruna	0.117
Kiruna-Svappavaara-Gällivare-Sandsele-Stensele-Mo i Rana-Fauske-Narvik-Kiruna	0.143

The absolute values used in RG 62 are listed in Table 35 (as from *Marzahn, Kneissl 1962*) and modern values are listed in Table 34.

Table 34: *Modern values of the points used as absolute points in the RG 62 tests (in mGal).*

	Observed with FG5-220 in 2003	Observed with FG5-226 in 2005	Observed with FG5-226 in 2011
København B (aka Buddinge P)	981543.186		
Oslo A			981912.538
Bodø A (aka Bodø Bankgata)		982372.234	

Table 35: *Absolute values used in RG 62 (in mGal).*

Name	RG 62	Modern value, reduced to epoch 1962.0	Diff (Modern – RG 62)
København B	981557.91	981543.194	-14.716
Oslo A	981927.29	981912.579	-14.711
Bodø A	982387.29	982372.262	-15.028

As can be seen, the absolute value in Bodø A was a gross error, which naturally affected the rest of the network.

Another important issue was to check whether the absolute values fitted together with the relative data (see Table 36).

Table 36: *Fit of absolute and relative values in RG 62 (in mGal), where the Absolute (Modern) values are reduced to epoch 1962.0 as in Table 35.*

	"Absolute" (1960s)	Absolute (Modern)	Relative (1960s)	Scale factor for Modern/Rel
Oslo A – København B with Worden Master 544	369.38	369.385	369.374	1.000030
Oslo A – København B with Worden 362	369.38	369.385	369.241	1.000390
Bodø A – Oslo A via Fauske with Worden Master 544	460.00	459.683	459.543	1.000305

As can be seen in Table 36, the difference between the absolute values in the 1960s and the modern values (reduced to 1962) is very small between Oslo A and København B. It also fits very well to the relative observations from the 1960s with Worden Master 544. The difference between Bodø A and Oslo A is large between the absolute values in 1960s and the modern values, but we attribute this to the gross error in the old absolute value of Bodø A. The relative observations differ slightly, as can be expected from such instruments. However, the scale factor between the modern and the relative instruments is quite different between the two northern points and the two southern points and when checking the data in RG 62, it is obvious that the scale factor for the northern points fit better together with almost the whole network.

After this was checked, several different calculations were performed to investigate whether the values in RG 62 could be reproduced in Gad via the adjusted observations and their uncertainty values.

The first way to calculate RG 62 with Gad was to try to get the original result. This was performed both with and without Bodø A and with and without the connections to Fauske or Kiruna A 1p. None of the results were even close to RG 62. Hence, we tried to use one scale factor for the network south of Oslo A and one scale factor north of Oslo A. For the southern part, the result was somehow similar to RG 62. For the northern parts it became more similar to RG 62 when using the same scale factor for the whole network, but still the new result was far from close. Another test was to calculate all the points and not only the junction points. Those results were also not even close to the results in RG 62.

The second way to calculate RG 62 with Gad was to use the nine "best" junction points in RG 2000 as absolute points (see Table 37), after converting them into epoch 1962.0. This led to inconsistent results.

Table 37: *The nine junction points with the "best" RG 2000 values (2018 realization). These are either Class B points or very close in g-range to a Class A or B point and are connected to that one through relative observations. Value in mGal.*

Name	g(RG 2000 in epoch 2000.0)	g (RG 2000 in epoch 1962.0)
Gällivare AA	982341.1625	982341.2122
Hörnefors 1p	982149.8928	982149.9561
Sollefteå AA	982123.6736	982123.7344
Östersund AB	982044.0936	982044.1460
Bollnäs AA	981994.5684	981994.6213
Skutskär 1p	981934.5827	981934.6300
Särna 1p	981905.9317	981905.9777
Göteborg 1p	981727.0836	981727.1039
Dörby 1p	981653.0248	981653.0384

A third and a fourth way to calculate RG 62 with Gad was to use the 16 A10 observations as absolute values in two different ways (see Table 38), after adjusting the observations for the land uplift. First by letting the software compute the scale factor. Second by using the scale factor 1 for the instrument, which is very close to what Table 33 showed for the southern parts.

Table 38: *Observed absolute values (mGal) reduced to the epochs 2000.0 and 1962.0 for 16 A10 points.*

Name	A10 (epoch 2000.0)	A10 (epoch 1962.0)
Gällivare AA	982341.1717	982341.2214
Luleå AA	982295.4764	982295.5369
Umbukta AA	982201.9080	982201.9453
Vilhelmina AA	982131.8128	982131.8688
Ragunda AA	982129.1823	982129.2410
Sollefteå AA	982123.6764	982123.7372
Hammerdal AA	982093.7961	982123.7372

Stugun AA	982088.0573	982088.1135
Östersund AB	982044.0957	982044.1481
Duved AA	982011.8280	982011.8716
Bollnäs AA	981994.5617	981994.6146
Älvdalen AA	981920.2395	981920.2873
Arboga AA	981837.7570	981837.7945
Ljusnarsberg AA	981836.8061	981836.8469
Ulricehamn AA	981681.2622	981681.2850
Eksjö AA	981672.9148	981672.9370

The conclusion of all these ways of calculating RG 62 in Gad is that it is not possible to get the same result as in RG 62. The gross error in the absolute observation in Bodø A might be one reason, but there are other reasons too.

Since the adjusted observations in RG 62 contain quite many gross errors, the scale factors are very hard to determine. This is confirmed by the different solutions above and when comparing the adjusted observations in RG 62 to either the differences between those of the points included in RG 2000 or the raw or adjusted observations by Pettersson in 1973 (see Subsection 7.2.1). Here, gross errors in RG 62 are obvious. Table 39 shows the most significant gross errors. Additionally, a small test was performed to check the if there were significant gross errors in the differences between three other point pairs. These differences were obtained by combining the RG 2000 value and the mean observed value in 1973 and then comparing them to the adjusted value in RG 62. An example is to get a somehow reasonable difference between Härryda 1p and Borås 1p through using the RG 2000 difference between Göteborg 1p and Borås 1p and then subtract the difference between Göteborg 1p and Härryda 1p from 1973. The result is shown in Table 40.

Note that the derived scale factor could be as large as 1.00075 for Worden Master 544 in all the different solutions, thus an exaggerated scale factor was tested in Table 39 and Table 40.

Table 39: *Overview of significant gross errors in RG 62. Column A: Points (names according to RG 2000); Column B: Difference between adjusted values in RG 62 and mean observed value in 1973; Column C: Difference between adjusted value in RG 62 and adjusted value in RG 2000 (2018 realization); Column D: Difference between adjusted value in RG 62 multiplied by 1.001 and mean observed value in 1973; Column E: Difference between adjusted value in RG 62 multiplied by 1.001 and adjusted value in RG 2000 (2018 realization). Column B-E are in µGal.*

A	B	C	D	E
Luleå AA – Morjärv 1p	-179		-155	

Sandsele 1p – Malå 1p – Norsjö 1p	+160		+177	
Örebro 1p – Askersund 1p - Karlsborg 1p	-132		-63	
Arboga AA – Eskilstuna 1p – Turinge 1p		-128		-117
Veinge 1p – Nöttja 1p - Ljungby 1p	-127		-83	
Härryda 1p – Borås 1p – Ulricehamn AA	-115		-89	
Ludvika 1p – Ludvika S 1p - Ljusnarsberg AA		-105		-66
Särna 1p – Idre 1p – Lillebo 1p	-98		-40	
Arboga AA – Örebro 1p		-94		-76
Karesuando 1p – Soppero 1p - Vittangi 1p	-91		-68	
Jönköping 1p – Nässjö 1p – Eksjö AA	+57	+90	+90	+123
Pello 1p – Övertorneå 1p	+51	+52	+88	+89
Pajala 1p – Pello 1p	+38	+42	+50	+55
Bollnäs AA – Söderhamn 1p		-47		-46
Göteborg 1p – Varberg 1p	+32		+65	
Svappavaara 1p – Moskojärvi 1p – Gällivare AA	+30		+59	

Table 40: *Multiples. Column A: Points (names according to RG 2000); Column B: Difference between adjusted values in RG 62 and mean observed value in 1973 in combination with adjusted value in RG 2000 (2018 realization); Column C: Difference between adjusted value in RG 62 multiplied by 1.001 and mean observed value in 1973 in combination with adjusted value in RG 2000 (2018 realization). Column B-C are in µGal.*

A	B	C
Härryda 1p – Borås 1p	-128	-105
Gällivare AA – Lansjärv 1p – Morjärv 1p	+80	+102
Karlsborg 1p – S Fågelås 1p	-56	-12

A final test with that dataset was to check whether if it was possible to use the RG 62 data to get better values for the points not included in RG 2000. This was performed in two different ways. First, one solution of the whole network was computed, where 62 points (the points from the main and second adjustment in 2018) were used as absolute points. 58 of these points were included the RG 2000 main adjustment (including 14 A10 points) and got their value from there. The point Uppsala B 1p got its value from the 1973 observations since the difference between Uppsala C 1p (included in the main adjustment) in RG 2000 was very close to the difference in RG 62. The point Norsjö 1p (which in all calculations above is an outlier) got its value from assuming the same g-value at Norsjö AA and the 1973 church step point and its short difference in the 1973 observations. Karesuando 1p got its value from Karesuando AA and its short difference in the 1973 observations. Finally, modern FG5 observations from København B were used (note that the modern FG5 observations from Oslo A and Bodø A were received some months after this test, which means that they were not available at the time). Second, all loops were computed using those of the 62 points included in the specific loop as absolute points. For most of the points the result was very consistent. Two loops showed less consistent values than the rest: Göteborg 1p – Jönköping 1p – Vislanda 1p – Veinge 1p – Göteborg 1p (where no "absolute points" were between Jönköping 1p and Varberg 1p on the southeast side, with the inconstistent points Hjälmseryd 1p, Ljungby 1p, Nöttja 1p and Vislanda 1p) and Östersund AB – Särna 1p – Vinstra – Stjördal – Östersund AB (where only 3 "absolute points" were included, with the inconsistent points Lillebo 1p, Sörvattnet 1p, Tännäs 1p, Vinstra and Stjördal). The rest of the loops had only a few points with inconsistent values. Note that some of the junction points got inconsistent values when comparing their values in different loops. Note that the values which are most similar to the later computed RG 2000 values in the 2019 realization are the values coming from the solution of the whole network and therefore that solution should be counted as the best of these two. Table 41 summarizes the difference between the solution of the whole network and the g-values computed from the 1973 observations.

Table 41: *Two different solutions of RG 62 points in RG 2000 (2018 realization). A: Name. B: Solution from the RG 62 data. C: Solution from the 1973-data. D: Difference B-C (µGal). E: Consistent within 25 µGal (Y/N) between when comparing B and the same data used in B but with the different loops.*

A	B	C	D	E
Vislanda 1p	981595.5423	981595.5313	11.0	N
Bulltofta 1p	981543.8861	981543.8366	49.5	N
Helsingborg A 1p	981609.6910	981609.6541	36.9	N
Veinge 1p	981656.3063	981656.3282	-21.9	N
Furudal 1p	981929.5069	981929.4855	21.4	N
Gudmundrå 1p	982105.4907	982105.5355	-44.8	Y
Bureå 1p	982225.4961	982225.4561	40.0	N
Sandsele 1p	982208.1948	982208.1957	-0.9	Y

Nysätra 1p	982216.3965	982216.4144	-17.9	Y
Örnsköldsvik 1p	982117.5903	982117.5919	-1.6	Y
Morjärv 1p	982319.3123	982319.4061	-93.8	N
Muodoslombolo 1p	982427.509	982427.5045	4.5	Y
Svappavaara 1p	982370.7516	982370.7597	-8.1	Y
Karungi 1p	982328.9359	982328.9704	-34.5	Y
Ljungby 1p	981612.1114	981612.0465	64.9	N
Härryda 1p	981708.0495	981708.0907	-41.2	Y
Karlsborg 1p	981750.6562	981750.6644	-8.2	Y
Leksand 1p	981907.8518	981907.8397	12.1	Y
Edsbyn 1p	981967.0768	981967.0615	15.3	Y
Åsarna 1p	982022.9254	982022.9862	-60.8	Y
Kallax 1p	982298.5634	982298.5649	-1.5	Y
Haparanda 2 1p	982325.4555	982325.5262	-70.7	Y
Lillebo 1p	981847.8386	981847.7772	61.4	N

We conclude that if the difference between the different solution is below 25 µGal, any of the solutions could have been chosen.

Another test can be performed by comparing the new solution to the transformed solution (see Table 42 and Table 43). As it should be expected that the transformed value should be regarded as least good, this comparison can point to possible outliers.

Table 42: *Column A: New name of the point. B: Old name of the point. C: Difference between the RG 2000 values calculated by using the RG 62 observations and the two-stepped transformed RG 2000 values. D: Consistency between the RG 2000 value derived from the whole network and the RG 2000 values derived from the loops (Y/N) within 25 µGal.*

A	B	C	D
Edsbyn 1p	14 15 2J Edsbyn, the bell-tower	97.3	Y
Karungi 1p	37 00 0J Karungi, Karl Gustav church	87.6	Y
Voxna 1p	14 15 1J Voxna, the railwaystation	85.2	Y
Furudal 1p	14 00 0J Furudal	81.9	N
Rättvik 1p	02 14 7J Rättvik, the church	80.7	Y
Eskilstuna 1p	01 02 2J Eskilstuna, Kloster church	80.4	Y

Leksand 1p	02 14 6J Leksand, the church	80.3	Y
Orsa 1p	13 14 3J Orsa, the church	74.3	N
Haparanda 2 1p	37 92 1J Haparanda, the mortuary	73.0	Y
Muodoslombolo 1p	35 00 0K Muodoslombolo, the chapel	68.9	Y
Ludvika S 1p	02 14 3J South of Ludvika	65.6	Y
Kihlanki 1p	35 36 1J Övre Kihlanki	60.9	Y
Soppero 1p	33 35 2J Nedre Soppero	60.2	Y
Helsingborg A 1p	09 00 0L Hälsingborg, S:t Maria church A	59.7	N
Hamrånge 1p	16 19 1J Hamrånge, the church	56.9	Y
Saxtorp 1p	08 09 1J Saxtorp, the church	56.1	Y
Porjus 1p	24 32 7J Porjus, the church	54.8	Y
Hudiksvall 1p	19 20 1J Hudiksvall, the church	53.6	Y
Slagnäs 1p	24 32 1J Slagnäs, the railwaystation	50.7	Y
Harmånger 1p	19 20 2J Harmånger, the church	49.2	Y
Bulltofta 1p	08 00 0J Bulltofta Airport	48.1	N
Moskojärvi 1p	32 33 1J Moskojärvi	45.8	Y
RAK 02 1p	01 00 0B Stockholm, RAK 2, gravimeter station	44.7	N
Tårrajaur 1p	24 32 5J Tårrajaur	44.7	Y
Moskosel 1p	24 32 3J Moskosel, the railwaystation	44.2	Y
Arlanda 1 1p	18 00 0J Arlanda Airport 1	42.1	Y
Lansjärv 1p	31 32 1J Övre Lansjärv	37.9	Y
Sandsele 1p	24 00 0J Sandsele	34.4	Y
Malå 1p	24 25 1A Malå, Sveriges Geologiska Undersökning	34.3	Y
Karlskoga 1p	02 12 1J Karlskoga	33.2	Y
Hörby 1p	07 08 1J Hörby, the church	30.2	Y
Transtrand 1p	12 13 5J Transtrand, the church	30.2	Y
Brunflo 1p	13 22 6J Brunflo, the church	28.7	Y
Strömsund 1p	23 83 1J: Strömsund	28.5	Y
Alsen 1p	22 82 1J Alsen, the church	25.6	Y
Morjärv 1p	31 00 0J Morjärv, the railwaystation	24.5	N
Finnfors 1 1p	25 30 1J Finnfors, the road junction	23.9	N

Vagnhärad 1p	01 04 1J Vagnhärad, the church	21.1	Y
Åsarna 1p	13 22 5J Åsarna	20.2	N
Storlien 1p	22 82 3J Storlien, the custom station	19.2	N
Graninge 1p	21 22 1J Graninge, the church	15.2	Y
Forsmark 1p	23 83 2J Forsmark	14.8	Y
Haparanda 1 1p	31 92 1J Haparanda, the church	13.9	Y
Lunda 1p	01 04 2J Lunda, the church	13.6	Y
Vimmerby 1p	03 04 3J Vimmerby, the church	12.9	Y
Svappavaara 1p	33 00 0J Svappavara, the fire station	12.6	Y
Askersund 1p	02 03 1J Askersund, the country parish church	10.2	Y
Hoting 1p	22 23 3J Hoting, the railwaystation	9.3	Y
Midlanda 1p	19 20 4J Midlanda Airport A	6.6	Y
Hede 1p	13 22 3J Hede, the church	6.1	N
Deje 1p	12 13 1J Deje	5.9	N
Tärnaby K 1p	23 83 3K Tärnaby, the church	5.8	Y
Klövsjö 1p	13 22 4J N Klövsjö	5.4	N
Gudmundrå 1p	20 00 0J Gudmundrå, the church	5.2	Y
Sölvesborg 1p	05 07 3J Sölvesborg, the church	3.9	Y
Veinge 1p	10 00 0J Veinge, the church	-0.1	N
Tännäs 1p	13 22 2J Tännäs, the church	-0.9	N
Bastuträsk 1p	25 00 0J Bastuträsk, the railwaystation	-2.5	N
Fulunäset 1p	12 13 6J Fulunäset	-2.7	Y
Vibyggerå 1p	20 28 1J Vibyggerå, the church	-3.0	Y
Lillebo 1p	13 81 2J Lillebo	-6.0	N
Hållstugan 1p	13 14 1J Hållstugan	-7.5	Y
Grundsunda 1p	28 29 1J Grundsunda	-8.3	Y
Örnsköldsvik 1p	28 00 0J Örnsköldsvik, the church	-9.0	Y
Valdemarsvik 1p	01 04 4J Valdemarsvik, Folkets Hus	-9.2	Y
Idre 1p	13 81 1J Idre, the church	-10.5	Y
Umfors 1p	23 83 4J Umfors	-10.7	Y
Härryda 1p	03 11 3J Härryda, the church	-10.9	Y
Olofsfors 1p	27 28 1J Olofsfors, the airport	-12.8	Y

Sörvattnet 1p	13 22 1J Sörvattnet	-14.2	N
Nöttja 1p	06 10 2J Nöttja, the church	-14.4	N
Ronneby 1p	05 07 2J Ronneby, the church	-14.7	Y
Bureå 1p	30 00 0K Bureå, the church	-15.2	N
Nysätra 1p	26 00 0J Nysätra, the church	-15.9	Y
Piteå 1p	30 31 2J Piteå	-16.0	Y
Nässjö 1p	03 04 1J Nässjö, the old church	-17.5	Y
Broby 1p	06 07 2J Broby, the church	-19.4	Y
Byske 1p	30 31 1J Byske	-20.1	Y
Ljungby 1p	06 10 1J Ljungby, the church	-23.9	N
Ishult 1p	04 05 1J Ishult	-25.4	Y
Kallax 1p	30 31 3J Kallax Airport	-26.2	Y
Karlsborg 1p	02 03 2J Karlsborg	-27.0	Y
Karlstad A 1p	12 00 0J Karlstad, the cathedral	-28.2	N
Hogstorp A 1p	11 80 1L Hogstorp, Röane estate A	-29.2	Y
Växjö 1p	05 06 2J Växjö, the cathedral	-41.6	Y
Vislanda 1p	06 00 0J Vislanda	-43.3	N
Hån 1p	12 80 2J Hån, the custom station	-57.8	Y
Hjälmseryd 1p	03 06 1J Nya Hjälmseryd, the school house	-59.0	N
Tanum A 1p	11 80 2K Tanum, the church A	-59.1	Y
Svinesund A 1p	11 80 3L Svinesund (this particular point is in Norway, other points in 11 80 3 are in Sweden)	-93.3	
	Mean	15.8	

Table 43: *Difference between the RG 2000 values (2018 realization) and the two-stepped transformed RG 2000 values. Column A: New name of the point. B: Old name of the point. C: Difference.*

A	B	C
Södra Fågelås 1p	02 03 3J S Fågelås, the church	-72.8
Jönköping 1p	03 00 0J Jönköping, Sofia church	-66.8
Vassijaure 1p	34 86 1J Vassijaure, the railwaystation	-61.8
Kiruna A 1p	34 00 0J Kiruna, the church	-57.7

Stenbrohult 1p	06 07 1J Stenbrohult, the church	-45.0
Algutsboda 1p	05 06 1J Algutsboda, the church	-44.0
Luleå AA	30 31 4J Luleå, the cathedral	-35.9
Jämjö 1p	05 07 1J Jämjö, the church	-25.3
Hörnefors 1p	29 00 0J Hörnefors, the church	-24.3
Borås 1p	03 11 2J Borås, Caroli church	-22.6
Umbukta AA	23 83 5J Umbukta	-21.9
Umeå 1p	27 00 0J Umeå, the cemetery	-20.3
Mönsterås 1p	04 05 2J Mönsterås, the church	-19.8
Ulricehamn AA	03 11 1J Ulricehamn, the church	-17.0
Särna 1p	13 00 0J Särna, the church	-16.3
Dörby 1p	05 00 0J Dörby, the church	-13.9
Karlstad B 1p	12 00 0K Karlstad Airport	-11.3
Göteborg 1p	11 0 0J Göteborg, Kristine church	-6.3
Granberget 1p	22 23 4J Granberget, the railwaystation	-2.7
RAK 04 1p	01 00 0D Stockholm, Hässelby, RAK 4	-2.4
Skönberga 1p	01 04 3J Skönberga, the church	-1.0
Sollefteå AA	21 00 0J Sollefteå, the church	3.2
Duved AA	22 82 2J Åre new church, Duved	4.9
Älvdalen AA	13 14 2J Älvdalen, the church	10.7
Vittangi 1p	33 35 1J Vittangi, the church	11.4
Varberg 1p	10 11 1L Varberg, Apelviksåsen A	12.5
Kristianstad 1p	07 00 0J Kristianstad, the church	12.8
Ström 1p	22 23 2J Ström, the church	22.8
Eksjö AA	03 04 2J Eksjö, the church	28.8
Sundsvall 1p	19 20 3K Sundsvall, Gustav Adolf church	29.3
Hammerdal AA	22 23 1J Hammerdal, the church	31.0
Turinge 1p	01 02 1J Turinge, the church	32.4
Vilhelmina AA	22 23 5J Vilhelmina, the church	36.3
Ljusnarsberg AA	02 14 2J Ljusnarsberg, the church	37.0
Ragunda AA	21 22 2J Ragunda, the church	37.1
Kåbdalis 1p	24 32 4J Kåbdalis, the church	37.6
Östersund AB	22 00 0J Östersund, the new church	37.6

Stugun AA	21 22 3J Stugun, the church	37.9
Norra Råda 1p	12 13 2J N Råda, the church	39.6
Norra Ny 1p	12 13 3J N Ny, the church	39.7
Uppsala B 1p	17 00 0B Uppsala Astronomical Observatory, site B	39.9
Uppsala C 1p	17 00 0C Uppsala Astronomical Observatory, site C	39.9
Jokkmokk 1p	24 32 6J Jokkmokk, the church 1	42.7
Gällivare AA	32 00 0J Gällivare, the church	46.8
Arvidsjaur 1p	24 32 2J Arvidsjaur, the church	49.5
Pajala 1p	35 36 2J Pajala, the church	56.9
Skutskär 1p	16 00 0J Skutskär, the church	58.3
Söderhamn 1p	19 00 0J Söderhamn, the church	59.8
Malung 1p	12 13 4J Malung, the church	61.4
Örebro 1p	02 00 0J Örebro, the castle	77.2
Lindesberg 1p	02 14 1J Lindesberg, the church	78.8
Ludvika 1p	02 14 4J Ludvika, the church	83.3
Stora Tuna 1p	02 14 5J Stora Tuna, the church	84.5
Pello 1p	36 00 0J Pello, the schoolhouse	88.9
Bollnäs AA	15 00 0K Bollnäs, the church	105.9
Arboga AA	01 02 3J Arboga, the church known as Heliga Trefaldighets Church	146.7
Övertorneå 1p	36 37 1J Övertorneå, the church	154.6
Norsjö 1p	25 24 2J Norsjö, the church	160.1

The result from Table 42 and Table 43 clearly show the inconsistency of the RG 62 data. The question arose which value should have been chosen in RG 2000 for the points in Table 42? The more the difference between the values grows, the more important it is to make the right choice. Mainly, there had been two options, either to use the transformed value or to use the calculated value with the RG 62 observations as relative observations and the land uplifted corrected RG 2000 observations as absolute observations. When the difference is <25 µGal, it would not have mattered which option would have been chosen in view of current uncertainties. If the difference is larger than that, we would have suggested to use observations from a short distance and gravity range as it is the case for the RG 62 observations rather than observations from a longer distance and larger gravity range as for the transformation based on 31 points in RG 62. Therefore, the solution from Gad would have been chosen here.

In view of the above one can also argue to use the points where we have LCR observations from 1973 instead of the RG 62 observations. However, also here consistency between the two used LCRs is often not given and thus we end up in a similar situation as above. The wish for the best possible solution must be compared though to the effort needed to achieve it and the scientific and/or practical relevance. The latter is only the case if the point should be used again or if the old geoid observations should be checked again and recalculated in RG 2000. Both exercises are unlikely and thus we decided in 2018 to finish further improvements with RG 62 data.

All these calculations above were performed before the summer of 2019. After that, some improvements were possible due to the following:

- Relative observations were performed between Class A or Class B points and the three junction points Bureå 1p, Nysätra 1p and Örnsköldsvik 1p.
- Relative observations were performed between LMV AA and Hamrånge 1p, which is not a junction point.
- One FG5 observation from Oslo A and one FG5 observation from Bodø A was delivered.
- More LCR observations between RG 62 points were found in the new Geodetic Archive.

A small "RG 62 renovation" was started where the RG 62 points finally could get usable values in RG 2000 by combining all these data and giving the observations more realistic weights, see Subsection 10.4.2.

Table 44 shows the difference between the 2019 realization of RG 2000 and the g-values derived for Table 42 and Table 43.

Table 44: *Gravity values of the RG 62 points in RG 2000. Column A: Name of the point in RG 2000; Column B: g-value in RG 2000 (2019 realization), in mGal; Column C: g-value in RG 2000 (2018 realization and calculated through only RG 62 data) in mGal; Column D: g-value in RG 2000 after transformation (see Subsection 12.2.5), Column E: Difference Column B – Column C. Column F: Difference Column B – Column D.*

A	B	C	D	E	F
RAK 01 1p	981831.4036		981831.4036		0.0000
RAK 02 1p	981831.0694	981831.1181	981831.0736	-0.0487	-0.0042
RAK 03 1p	981827.9308		981827.9431		-0.0123
RAK 04 1p	981827.9278		981827.9331		-0.0053
Bromma 2 1p	981830.8727		981830.8735		-0.0008
Tureberg 1p	981818.515		981818.5346		-0.0196
Pustnäs 1 1p	981886.6114		981886.5874		0.0240
Pustnäs 2 1p	981886.3757		981886.3474		0.0283

Turinge 1p*	981826.5811		981826.548		0.0331
Eskilstuna 1p	981836.1559	981836.1459	981836.0655	0.0100	0.0904
Arboga AA*	981837.7594		981837.615		0.1444
Vagnhärad 1p	981815.1438	981815.1656	981815.1424	-0.0218	0.0014
Lunda 1p	981802.5234	981802.5304	981802.5162	-0.0070	0.0072
Skönberga 1p	981780.3171		981780.319		-0.0019
Valdemarsvik 1p	981767.5207	981767.5172	981767.5252	0.0035	-0.0045
Örebro 1p*	981819.9859		981819.9121		0.0738
Askersund 1p	981805.7777	981805.7604	981805.7486	0.0173	0.0291
Karlsborg 1p	981750.6638	981750.6562	981750.6818	0.0076	-0.0180
S Fågelås 1p*	981704.6647		981704.7345		-0.0698
Karlskoga 1p	981802.3643	981802.3583	981802.3296	0.0060	0.0347
Lindesberg 1p*	981831.5292		981831.4529		0.0763
Ljusnarsberg AA	981836.7972		981836.7649		0.0323
S Ludvika 1p	981860.8141	981860.8128	981860.7482	0.0013	0.0659
Ludvika 1p*	981876.343		981876.2677		0.0753
Stora Tuna 1p*	981907.2377		981907.153		0.0847
Leksand 1p	981907.8408	981907.8518	981907.7722	-0.0110	0.0686
Rättvik 1p	981924.1941	981924.2038	981924.1237	-0.0097	0.0704
Jönköping 1p*	981705.8085		981705.866		-0.0575
Nässjö 1p	981673.6878	981673.6701	981673.6873	0.0177	0.0005
Eksjö AA*	981672.9194		981672.8883		0.0311
Vimmerby 1p	981694.9189	981694.9248	981694.9119	-0.0059	0.0070
Hjälmseryd 1p	981634.0247	981634.0383	981634.0956	-0.0136	-0.0709
Ulricehamn AA	981681.2708		981681.2874		-0.0166
Borås 1p*	981685.7595		981685.7822		-0.0227
Härryda 1p	981708.1043	981708.0495	981708.0598	0.0548	0.0445
Tjust 1p	981720.2141		981720.2302		-0.0161
Ishult 1p	981684.3878	981684.3840	981684.4077	0.0038	-0.0199
Mönsterås 1p*	981666.9924		981667.0078		-0.0154
Dörby 1p*	981653.027		981653.0373		-0.0103

Algutsboda 1p*	981620.1251		981620.168		-0.0429
Växjö 1p	981621.2998	981621.2876	981621.3299	0.0122	-0.0301
Jämjö 1p*	981611.9175		981611.9408		-0.0233
Ronneby 1p	981614.162	981614.1574	981614.1722	0.0046	-0.0102
Sölvesborg 1p	981593.8161	981593.8192	981593.8149	-0.0031	0.0012
Vislanda 1p	981595.5294	981595.5423	981595.5881	-0.0129	-0.0587
Stenbrohult 1p*	981595.407		981595.4497		-0.0427
Broby 1p	981596.5218	981596.5206	981596.5388	0.0012	-0.0170
Ljungby 1p	981612.0521	981612.1114	981612.1277	-0.0593	-0.0756
Nöttja 1p	981616.8174	981616.8374	981616.8533	-0.0200	-0.0359
Kristianstad 1p*	981591.2854		981591.2709		0.0145
Hörby 1p	981575.6392	981575.6572	981575.6242	-0.0180	0.0150
Bulltofta 1p	981543.8445	981543.8861	981543.8366	-0.0416	0.0079
Saxtorp 1p	981569.5968	981569.6416	981569.5853	-0.0448	0.0115
Helsingborg B 1p	981609.8307		981609.8123		0.0184
Helsingborg Stn 1p	981610.0509		981610.0317		0.0192
Helsingborg A 1p	981609.6556	981609.6910	981609.6313	-0.0354	0.0243
Veinge 1p	981656.3221	981656.3063	981656.3084	0.0158	0.0137
Varberg Stn 1p	981701.9388		981701.9214		0.0174
Varberg B 1p	981696.3344		981696.3189		0.0155
Varberg 1p	981694.842		981694.8274		0.0146
Göteborg 1p	981727.0833		981727.0918		-0.0085
Göteborg 2 1p	981723.5911		981723.6017		-0.0106
Göteborg 3 1p	981726.2727		981726.2799		-0.0072
Hogtorp C 1p	981755.5927		981755.604		-0.0113
Hogtorp B 1p	981752.9309		981752.9437		-0.0128
Hogtorp A 1p	981752.1834	981752.1622	981752.1914	0.0212	-0.0080
Tanum B 1p	981786.2127		981786.2361		-0.0234
Tanum A 1p	981785.613	981785.5766	981785.6361	0.0364	-0.0231
Svinesund C 1p	981825.555		981825.5919		-0.0369

Svinesund B 1p	981837.3021		981837.3318		-0.0297
Svinesund A**	981837.6774	981837.6175	981837.7108	0.0599	-0.0334
Klevberget**	981888.1479		981888.1832		-0.0353
Karlstad A 1p	981828.2647	981828.2235	981828.2551	0.0412	0.0096
Karlstad B 1p	981829.5157		981829.5048		0.0109
Deje	981835.4485	981835.4301	981835.425	0.0184	0.0235
Norra Råda 1p*	981831.7424		981831.7012		0.0412
Norra Ny 1p*	981843.1631		981843.1234		0.0397
Malung 1p*	981845.7091		981845.6471		0.0620
Transtrand 1p	981867.0894	981867.0760	981867.0472	0.0134	0.0422
Fulunäset 1p	981886.4115	981886.3934	981886.3963	0.0181	0.0152
Silbodal A 1p	981820.0918		981820.1208		-0.0290
Hån 1p	981834.6757	981834.6491	981834.701	0.0266	-0.0253
Fossum**	981878.6445		981878.6852		-0.0407
Särna 1p*	981905.9362		981905.9544		-0.0182
Hållstugan 1p	981885.6209	981885.6208	981885.6361	0.0001	-0.0152
Älvdalen AA*	981920.2416		981920.2307		0.0109
Orsa 1p	981935.2412	981935.2665	981935.1929	-0.0253	0.0483
Sörvattnet 1p	981867.7184	981867.7243	981867.7375	-0.0059	-0.0191
Tännäs 1p	981893.3230	981893.3367	981893.3356	-0.0137	-0.0126
Hede 1p	981944.5399	981944.5173	981944.5124	0.0226	0.0275
Klövsjö 1p	981956.1043	981956.0600	981956.0578	0.0443	0.0465
Åsarna 1p	982022.9831	982022.9254	982022.9068	0.0577	0.0763
Brunflo 1p	982035.8347	982035.7958	982035.7681	0.0389	0.0666
Idre 1p	981906.1189	981906.1362	981906.1434	-0.0173	-0.0245
Lillebo 1p	981847.7833	981847.8386	981847.8393	-0.0553	-0.0560
Furudal 1p	981929.4861	981929.5069	981929.4275	-0.0208	0.0586
Voxna 1p	981968.6828	981968.6932	981968.6124	-0.0104	0.0704
Edsbyn 1p	981967.0612	981967.0768	981966.9806	-0.0156	0.0806
Bollnäs Åsen 1p	981987.6856		981987.5923		0.0933
Bollnäs AA*	981994.5704		981994.4726		0.0978
Skutskär 1p*	981934.5809		981934.5224		0.0585
Hamrånge 1p*	981965.894	981965.9310	981965.8731	-0.0370	0.0209

Uppsala A 1p	981884.3787		981884.3324		0.0463
Uppsala B 1p	981884.4087		981884.3624		0.0463
Uppsala C 1p*	981883.8062		981883.765		0.0412
Arlanda 1 1p	981850.4569	981850.4998	981850.4522	-0.0429	0.0047
Arlanda 2 1p	981851.6247		981851.6268		-0.0021
Söderhamn 1p*	981993.2941		981993.2421		0.0520
Hudiksvall 1p	982020.8211	982020.8519	982020.8056	-0.0308	0.0155
Harmånger 1p	982034.2563	982034.2487	982034.2083	0.0076	0.0480
Sundsvall N 1p	982045.9142		982045.9106		0.0036
Sundsvall 1p*	982069.8809		982069.8536		0.0273
Midlanda A 1p	982087.2724	982087.2284	982087.2236	0.0440	0.0488
Midlanda B 1p	982086.6134		982086.563		0.0504
Gudmundrå 1p	982105.5478	982105.4907	982105.485	0.0571	0.0628
Vibyggerå 1p	982116.2268	982116.2042	982116.2087	0.0226	0.0181
Sollefteå AA*	982123.6718		982123.671		0.0008
Graninge 1p	982092.5383	982092.5437	982092.5287	-0.0054	0.0096
Ragunda AA*	982129.181		982129.144		0.0370
Stugun AA*	982088.0588		982088.0181		0.0407
Östersund AB*	982044.092		982044.052		0.0400
Frösön 1p	982026.8217		982026.8112		0.0105
Hammerdal AA*	982093.8005		982093.7665		0.0340
Ström 1p*	982108.2604		982108.2378		0.0226
Hoting 1p	982135.7656	982135.7599	982135.7527	0.0057	0.0129
Granberget 1p*	982119.5372	982119.5437	982119.5446	-0.0065	-0.0074
Vilhemina AA*	982131.8182		982131.7807		0.0375
Alsen 1p	982031.2051	982031.1978	982031.1692	0.0073	0.0359
Duved AA*	982011.8347		982011.8213		0.0134
Storlien 1p	981977.1794	981977.2234	981977.1955	-0.0440	-0.0161
Stensele A 1p	982174.9266		982174.8897		0.0369
Strömsund 1p	982175.9091	982175.9021	982175.8756	0.0070	0.0335
Forsmark 1p	982167.7143	982167.7125	982167.7002	0.0018	0.0141
Tärnaby A 1p	982155.099	982155.1082	982155.1048	-0.0092	-0.0058

Tärnaby K 1p	982154.0289		982154.0268		0.0021
Umfors 1p	982169.3658	982169.3675	982169.3726	-0.0017	-0.0068
Umbukta AA*	982201.9146		982201.9276		-0.0130
Sandsele 1p	982208.1954	982208.1948	982208.1661	0.0006	0.0293
Malå 1p	982221.8077	982221.7330	982221.706	0.0747	0.1017
Norsjö 1p	982191.6088		982191.4704		0.1384
Slagnäs 1p	982211.9254	982211.9415	982211.8977	-0.0161	0.0277
Arvidsjaur 1p*	982216.0559		982216.0171		0.0388
Moskosel 1p	982244.6083	982244.6100	982244.5662	-0.0017	0.0421
Kåbdalis 1p*	982271.1726		982271.1347		0.0379
Tårrajaur 1p	982306.1666	982306.1750	982306.1264	-0.0084	0.0402
Jokkmokk 1p*	982346.9184		982346.8772		0.0412
Jokkmokk 2 1p	982347.2084		982347.1661		0.0423
Porjus 1p	982317.1881	982317.2078	982317.1494	-0.0197	0.0387
Bastuträsk 1p	982193.1094	982193.1083	982193.0843	0.0011	0.0251
Finnfors 1 1p	982196.0662	982196.1176	982196.0981	-0.0514	-0.0319
Finnfors 2 1p	982196.1809		982196.2128		-0.0319
Nysätra 1p*	982216.4130	982216.3965	982216.4175	0.0165	-0.0045
Umeå 1p	982188.2216		982188.2556		-0.0340
Olovsfors 1p	982152.2193	982152.2208	982152.2341	-0.0015	-0.0148
Örnsköldsvik 1p*	982117.5712	982117.5903	982117.5994	-0.0191	-0.0282
Grundsunda 1p	982129.6344	982129.6443	982129.6528	-0.0099	-0.0184
Hörnefors 1p*	982149.8925		982149.9171		-0.0246
Bureå N 1p	982221.0697		982221.1507		-0.0810
Bureå 1p*	982225.4329	982225.4961	982225.511	-0.0632	-0.0781
Byske 1p	982242.6008	982242.6483	982242.6682	-0.0475	-0.0674
Piteå 1p	982286.6141	982286.6405	982286.6557	-0.0264	-0.0416
Kallax 1p	982298.5569	982298.5634	982298.5883	-0.0065	-0.0314
Luleå AA*	982295.4723		982295.5082		-0.0359
Morjärv 1p	982319.4011	982319.3123	982319.2853	0.0888	0.1158
Lansjärv 1p	982363.235	982363.1831	982363.1413	0.0519	0.0937
Haparanda 1 1p	982324.8707	982324.7963	982324.7805	0.0744	0.0902

Gällivare AA*	982341.1583		982341.1106		0.0477
Moskojärvi 1p	982345.9118	982345.9201	982345.8685	-0.0083	0.0433
Svappavaara 1p	982370.7546	982370.7516	982370.7333	0.0030	0.0213
Vittangi 1p	982405.5137		982405.4987		0.0150
Soppero 1p	982377.5431	982377.5659	982377.4986	-0.0228	0.0445
Karesuando 1p	982428.1191		982428.0369		0.0822
Kiruna A 1p	982315.3467		982315.4141		-0.0674
Kiruna B 1p	982340.0341		982340.0477		-0.0136
Vassijaure 1p*	982341.5725		982341.6328		-0.0603
Björnfjell**	982340.9539		982340.9447		0.0092
Muodoslombolo 2 1p	982432.8491		982432.7797		0.0694
Muodoslombolo 1p	982427.5053	982427.5090	982427.4413	-0.0037	0.0640
Kihlanki 1p	982395.5533	982395.5629	982395.5017	-0.0096	0.0516
Pajala 1p*	982379.2599		982379.209		0.0509
Pello 1p*	982366.7427		982366.6621		0.0806
Övertorneå 1p*	982329.5543		982329.4127		0.1416
Karungi 1p	982328.9710	982328.9359	982328.861	0.0351	0.1100
Haparanda 2 1p	982325.5227	982325.4555	982325.3884	0.0672	0.1343
København B**	981543.1936		981543.1038		0.0898
Oslo A**	981912.5433		981912.5706		-0.0273
Oslo B**	981914.0759		981914.0891		-0.0132
Vinstra A**	981904.6443		981904.7145		-0.0702
Stjördal**	982141.6462		982141.6578		-0.0116
Mo i Rana J**	982309.5867		982309.5473		0.0394
Mo i Rana K**	982308.7931		982308.7367		0.0564
Mo i Rana L**	982307.6598		982307.6605		-0.0007
Bodö A**	982372.2625		982372.5609		-0.2984
Bodö B**	982371.4765		982371.7709		-0.2944
Fauske**	982322.9036		982322.9197		-0.0161
Narvik J**	982437.0629		982437.1159		-0.0530
Narvik K**	982436.8311		982436.8759		-0.0448

Narvik M**	982438.4148		982438.2359		0.1789
Koivulahti**	982099.5622		982099.6772		-0.1150
Kemi**	982308.0946		982307.9899		0.1047

Note that the transformation gives a much better result for the two points in Narvik, to where the relative observations are the better, than for the point Narvik M (main point in RG 62) to where the relative observations are bad and that no transformation whatsoever could be good for the two points in Bodø due to the giant gross error in the absolute observation.

If using the official transformation between RG 62 and RG 2000 and excluding the points not situated in Sweden, there are 7 points which g-values get more than 100 µGal wrong and 39 points which g-values get between 50 and 100 µGal wrong in RG 2000 (see Table 44, Column F). Since most of the detail gravity points in Sweden has the original system RG 62 and since the database is lacking the information of which point is the starting (and ending) point in the sequence the detail gravity point was measured, the transformation itself is important for the quality of the next computed geoid. The very best thing would be to go through all the old protocol books and manually find the starting and ending points of all geoid points. This is however a large job to do, but still it would be the very best. Another good option would be just to do this for the points in the areas where the transformation is the least good, which means around these 7 points where the error exceeds 100 µGal or even the additional 46 points where the error exceeds 50 µGal. Since it is impossible to recalculate all the geoid points (for the ones measured with Worden we lack the conversion tables, for the ones measured with LCR we have still a software, but it is extremely time consuming to recalculate them), the procedure would be to use the known difference between the g-value in RG 62 and the g-value in RG 2000 for the starting point and apply it to all geoid points measured in the same sequence. In case the starting point and the ending point would not be the same, both values should be used either by using an average of the known differences or by using a drift sequence between these known differences.

Note that this is most important in Tornedalen (from Haparanda and north) where the transformation leads to large systematical errors, This is also important in Hälsingland, in Dalarna, along the Västerbotten and Norrbotten coast and in the western parts of Småland and very important around the points where there are known gross errors in RG 62, which means Norsjö, Morjärv and Arboga. Another question to solve how to do with the island of Gotland which was not included in the original RG 62. The most likely answer here is to find the starting points and not to use any transformation.

Reports in Geodesy and Geographical Information Systems from Lantmäteriet (the Swedish mapping, cadastral and land registration authority)

2011:3 Liu Ke: A study of the possibilities to connect local levelling networks to the Swedish height system RH 2000 using GNSS.

2012:3 Lundell Rebecka: Undersökning av nätverks-RTK-meddelande tillsammans med olika GNSS-mottagare – vid nätverks-RTK-mätning i SWEPOS nät av fasta referensstationer.

2014:2 Vestøl Olav, Eriksson Per-Ola, Jepsen Casper, Keller Kristian, Mäkinen Jaakko, Saaranen Veikko, Valsson Guðmundur, Hoftuft Olav: Review of current and near-future levelling technology – a study project within the NKG working group of Geoid and Height Systems.

2014:5 Ohlsson Kent: Studie av mätosäkerhet och tidskorrelationer vid mätning med nätverks-RTK i SWEPOS 35 km-nät.

2015:1 Fredriksson Annika & Olsson Madeleine: Jämförelse av höjdmätning med olika GNSS-mottagare i SWEPOS Nätverks-RTK-tjänst.

2015:2 Norin Dan, Johansson Jan M, Mårtensson Stig-Göran, Eshagh Mehdi: Geodetic activities in Sweden 2010–2014.

2015:4 Andersson Bengt, Alfredsson Anders, Nordqvist Anders, Kilström Ronald: RIX 95-projektet – slutrapport.

2016:1 Engfeldt Andreas: RG 2000 – status March 2016.

2016:2 Engfeldt Andreas: Preparations and plans for the new national gravity system, RG 2000.

2016:4 Kempe Christina (ed.): Proceedings of the NKG General Assembly. Göteborg, Sweden, 1–4 September 2014.

2016:5 Berggren Anna: Inledande försök till mätning med Europas navigeringssystem Galileo.

2018:3 Svensson Vilhelm & Tobler Fredrik: Utvärdering av olika metoder för fri stationsetablering med nätverks-RTK.

2018:4 Norin Dan, Jensen Anna B O, Bagherbandi Mohammad, Eshagh Mehdi: Geodetic activities in Sweden 2014–2018.

2018:5 Jivall Lotti & Nilfouroushan Faramarz: Mast-based versus pillar-based networks for coordinate estimation of SWEREF points – using the Bernese and GAMIT-GLOBK software packages.

2019:1 Alfredsson Anders, Alm Linda, Dahlström Fredrik, Jivall Lotti, Kempe Christina, Wiklund Peter: Förvaltning av de nationella geodetiska referensnäten.

LANTMÄTERIET

801 82 Gävle Phone 0771 - 63 63 63 E-mail lantmateriet@lm.se
Internet: www.lantmateriet.se