Gravity survey at McMurdo Station, Scott Base, Cape Roberts, and Mario Zucchelli Station, Antarctica, 19 November-11 December 2015

Field Technical Report by

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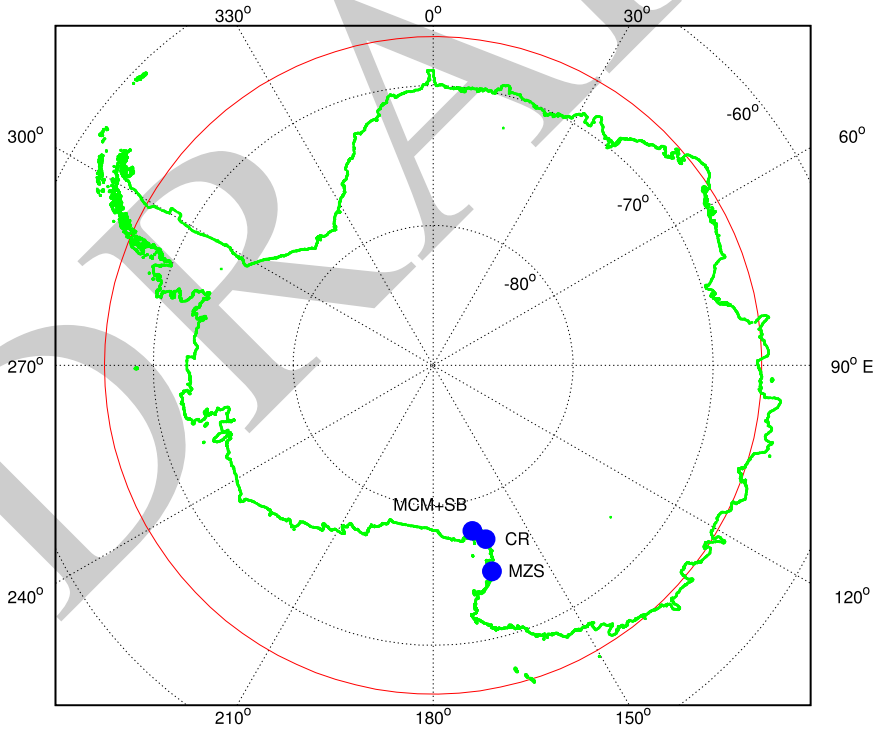
Abstract

From 19 November until 11 December 2015, absolute gravity observations were conducted at the USGS THIEL gravity benchmark at McMurdo Station (US), LINZ SBG1 benchmark at Scott Base (NZ), LINZ ROBE benchmark at Cape Roberts (NZ) and TNB AB and IAGS benchmarks at Mario Zucchelli Station (I) in Antarctica, using the gravimeter FG5 #206. Previous occupations with FG5 gravimeters date back to 2009 and 2011 for the THIEL and SBG1 stations, 1997 for the ROBE station, 1995, 1997, 2009 and 2011 for the TNB AB station, and 2011 for the IAGS station.

Between 23 November and 11 December 2015, THIEL-2, Hut Point and Radarsat benchmarks at McMurdo Station and SBG1 and MMD-N benchmarks at Scott Base have been tied to THIEL station, the CRN2 benchmark at Cape Roberts has been tied to ROBE station, and the relative gravity stations IRGS-A and B at Mario Zucchelli Station have been tied to TNB AB Station with a Scintrex CG-5 gravimeter.



McMurdo Station (MCM) and Scott Base (SB),
Cape Roberts (CR) and Mario Zucchelli Station (MZS).

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22° solar halo at Mario Zucchelli Station.

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Chapter 1

Introduction

1.1 Gravity survey in Antarctica

Originally, the goal of the gravity survey described in the present report was to make Absolute Gravity (AG) and Relative Gravity (RG) measurements at McMurdo Station (MCM) and Scott Base (SB) on Ross Island, Cape Roberts (CR), Mario Zucchelli Station (MZS) in Terra Nova Bay and Dumont d'Urville (DDU) in Terre Adélie. However, because of bad weather conditions, the transportation by plane to DDU was cancelled. Consequently, no observation was made at DDU.

In the following chapters, we successively report on the observations made at MCM, SB, CR and MZS. Where available, we compare the observations to measurements previously made at the same locations.

This paper is complementary to the reports by Rogister et al. (2009) and Rogister et al. (2011) of the similar 2009 and 2011 campaigns, hereafter referred to as Report I and Report II, respectively. However, necessary information, such as geographical coordinates or environmental and instrumental parameters, is reproduced in the present report to make it self-contained.

1.2 Financial and logistical supports

The 2015 AG survey in Antarctica is a part of the international POLENET. Initiated as a part of project 337 *Variation de gravité et mouvement vertical dans les régions polaires - Apport aux problèmes du rebond post-glaciaire et de la déglaciation actuelle* funded by the French Institut Paul-Emile Victor (IPEV), it also much benefited from the support of the Italian Programma Nazionale di Ricerche in Antartide (PNRA), Land Information New Zealand (LINZ), Antarctica New Zealand (ANZ), and US Antarctic Program (USAP) managed by the National Science Foundation (NSF).

The observations at CR have necessitated significant logistical efforts from both LINZ and ANZ. A tent and a heater (Figs 1.1 and 4.1) have been transported and installed on site on 24 November 2015, which was the day before the gravity equipment and team arrived. They were dismounted and transported back to Scott Base on 30 November. Moreover, as in 2009 and 2011, a heated hut has been temporarily installed over SBG1 benchmark at Scott Base.

The transportations by air to and from MZS have been made on a Basler and a Twin-Otter chartered by the NSF and PNRA, respectively.

1.3 Equipment

The AG observations were conducted with the free-fall FG5 #206 gravimeter designed by Micro-g Lacoste, owned by the French Institut National des Sciences de l'Univers (INSU). Observations consisted of sets of 100 drops, one drop every 10 seconds, which were hourly repeated. The AG raw data are corrected for Earth

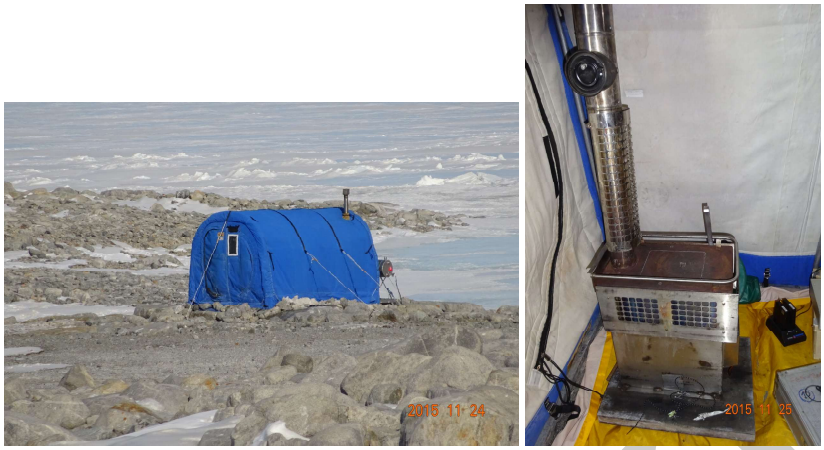

Figure 1.1: Blue tent and heater set up over the LINZ ROBE benchmark.

tide, ocean loading, polar motion and atmospheric pressure. The corrections and instrumental parameters are given, for each station, in Appendix F.

The RG observations and gravity gradient measurements were made with a Scintrex CG-5 gravimeter.

Chapter 2

McMurdo Station (US)

2.1 AG at THIEL Station

THIEL gravity station, whose geographical coordinates are given in Table 2.1, is established in Building 146 (Fig. 2.1 in Report I) at McMurdo Station on Ross Island . THIEL benchmark is on a concrete pier inside the building (Fig 2.2 in Report I) and THIEL-2 benchmark is on a concrete pier outside the building (Fig. 2.6 in Report I). We only occupied THIEL station with the FG5 gravimeter (Fig 2.1 in Report II) and linked THIEL-2 to THIEL with the CG-5 Scintrex relative meter (Section 2.2).

This was the third AG measurement at THIEL station. The first and second ones had taken place in November 2009 (Report I) and November 2011 (Report II), respectively. The observations used to obtain the values given in Table 2.2 ran from 19 until 21 November 2015 (local time). Sets of 100 drops were hourly repeated. The mean gravity values measured in 2009, 2011 and 2015 at the ground level and 1 m above ground are given in Table 2.2.

In 2009 and 2011, the redundant fuel tank nearby Thiel hut was empty. This time, it was filled up to $h = 3.594$ m. The density of the fluid being 816 kg/m^3, its influence on the gravity can be computed by using Eq. (D15) of Report I. It is only 0.38 μGal.

2.2 Gravity links to THIEL-2, Hut Point and Radarsat building

On 23 November 2015, the THIEL-2 (Fig. 2.3 in Report II) and Hut Point (Fig. 2.2 below and Fig. 2.6 in Report I) benchmarks were linked to THIEL station. The Radarsat building (Fig. 2.3) was tied to THIEL station on 24 November 2015. The gravity at those three sites is given in Table 2.3.

Table 2.1: Geographical coordinates of and vertical gravity gradient at THIEL station.

Station	Latitude (°)	Longitude (°)	Elevation (m)	dg/dz (μGal/cm)
THIEL	77.8490 S	166.6794 E	46.21	-3.114 $\pm$ 0.030

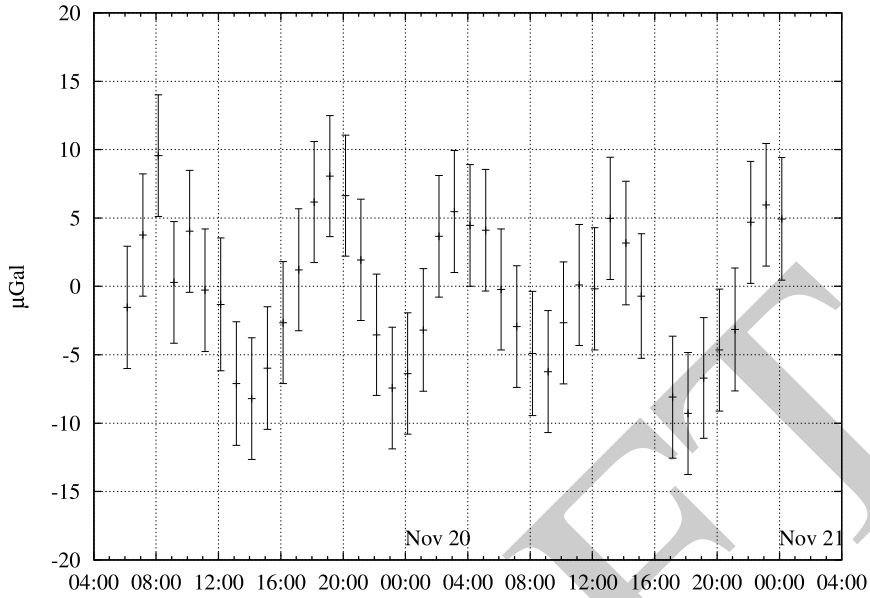

Figure 2.1: AG time series at ground level at THIEL Station. Time is UT. The resulting AG value is given in Table 2.2.

Table 2.2: AG at THIEL Station at ground level and 1 m above ground.

Year	Reference	Altitude above ground (m)	g (μGal)
2009	Report I	0	982 970 532.28 $\pm$ 4.30
2009	Report I	1	982 970 220.88 $\pm$ 2.07
2011	Report II	0	982 970 543.42 $\pm$ 4.39
2011	Report II	1	982 970 232.02 $\pm$ 2.14
2015	This report	0	982 970 548.43 $\pm$ 4.44
2015	This report	1	982 970 237.03 $\pm$ 2.24

Table 2.3: Gravity at the Radarsat building and THIEL-2 and Hut Point benchmarks, measured with a Scintrex CG-5 relative gravimeter from the THIEL absolute station.

Station	Year	Reference	g (μGal)
THIEL-2	2011	Report II	982 970 861.2 $\pm$ 6.7
THIEL-2	2015	This report	982 970 871.1 $\pm$ 8.6
Hut Point	2009	Report I	982 975 754 $\pm$ 15
Hut Point	2015	This report	982 975 783 $\pm$ 15
Radarsat	2009	Report I	982 945 942 $\pm$ 15
Radarsat	2015	This report	982 945 988 $\pm$ 9

Figure 2.2: Hut Point Station.

Figure 2.3: Radarsat building 71 and benchmark at Radarsat Station. The benchmark is located on the pilar on the lower left corner of the left picture.

Chapter 3

Scott Base (NZ)

3.1 AG at SBG1 Station

We occupied the station SBG1 (Figs 3.1 and 3.2 in Report I) from 21 until 23 November 2015 (local time). Its geographical coordinates are given in Table 3.1. This was the third AG measurement at SBG1 station.

Table 3.1: Geographical coordinates of and vertical gravity gradient at SBG1 Station

Station	Latitude (°)	Longitude (°)	Elevation (m)	dg/dz (μGal/cm)
SBG1	77.8489 S	166.7691 E	9.1	-3.491 $\pm$ 0.030

The first and second ones had taken place in November 2009 (Report I) and December 2011 (Report II), respectively. A hut, shown in Figure 3.1, was installed for the duration of the observations. The good-quality data shown in Fig. 3.2 provide the AG value given in Table 3.2. The mean gravity values measured in 2009 and 2011 at the ground level and 1 m above ground are also given in Table 3.2.

Table 3.2: AG at SBG1 Station at ground level and 1 m above ground.

Year	Reference	Altitude above ground (m)	g (μGal)
2009	Report I	0	982 977 945.91 $\pm$ 4.34
2009	Report I	1	982 977 596.81 $\pm$ 2.15
2011	Report II	0	982 977 940.22 $\pm$ 4.32
2011	Report II	1	982 977 591.12 $\pm$ 2.10
2015	This report	0	982 977 947.71 $\pm$ 4.38
2015	This report	1	982 977 598.61 $\pm$ 2.11

3.2 Gravity link to Seismic Hut Station

On 24 November, both SBG1 and the MMD-N station (Table 3.3) located near the seismic hut (Fig. 3.3), were tied to the absolute reference station THIEL at MCM. The gravity at MMD-N is given in Table 3.4.

Figure 3.1: Hut (top) and FG5 # 206 (bottom) installed over SBG1 benchmark.

Table 3.3: Geographical coordinates of MMD-N Station

Station	Latitude (°)	Longitude (°)	Elevation (m)
MMD-N	77.8491 S	166.7567 E	33.2

Table 3.4: Gravity at MMD-N Station (Seismic Hut) measured by means of ties.

Year	Reference	g (μ Gal)
2009	Report 1	982 973 537 $\pm$ 15
2015	This report	982 973 533 $\pm$ 12

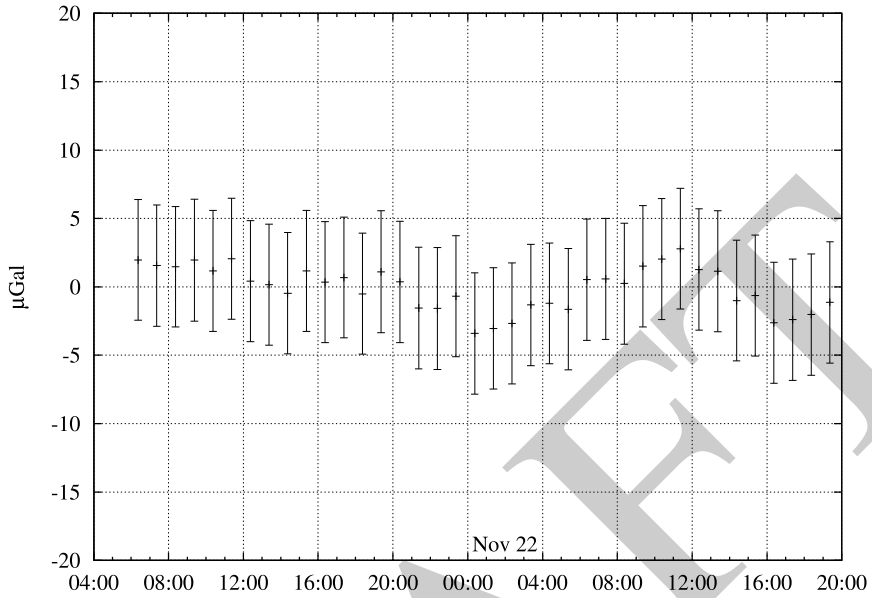

Figure 3.2: AG time series at ground level at SBG1 Station. Time is UT. The resulting AG value is given in Table 3.2.

Figure 3.3: Seismic hut (top) over Scott Base and adjacent MMD-N benchmark (bottom).

Chapter 4

Cape Roberts (NZ)

4.1 AG at ROBE station

For the first time since 1997 the ROBE benchmark (Table 4.1) has been occupied with a FG5 gravimeter. The latter was installed in a heated tent set up for the duration of the observations (Figs 1.1 and 4.1), which lasted from 25 until 28 November 2015. The mark is sealed in a flat rock approximately 50 meters away from the ANZ shelter (Fig. 4.1 in Report I and Fig. 4.1 below). The vertical gravity gradient of Table 4.1 is given by Mäkinen et al. (2007). Although it was used for processing the 1997 and 2015 observations, we remeasured it on 28 November 2015 and obtained -3.637 $\pm$ 0.103 μGal/cm. The hourly AG data shown in Fig. 4.2 provide the value given in Table 4.2.

Table 4.1: Geographical coordinates of and vertical gravity gradient at ROBE station. The latter is given by Mäkinen et al. (2007).

Station	Latitude (°)	Longitude (°)	Elevation (m)	dg/dz (μGal/cm)
ROBE	77.035 S	163.1792 E	2.8	-3.20

Figure 4.1: Blue tent (top) set up over the LINZ ROBE benchmark and FG5 meter inside the tent (bottom).

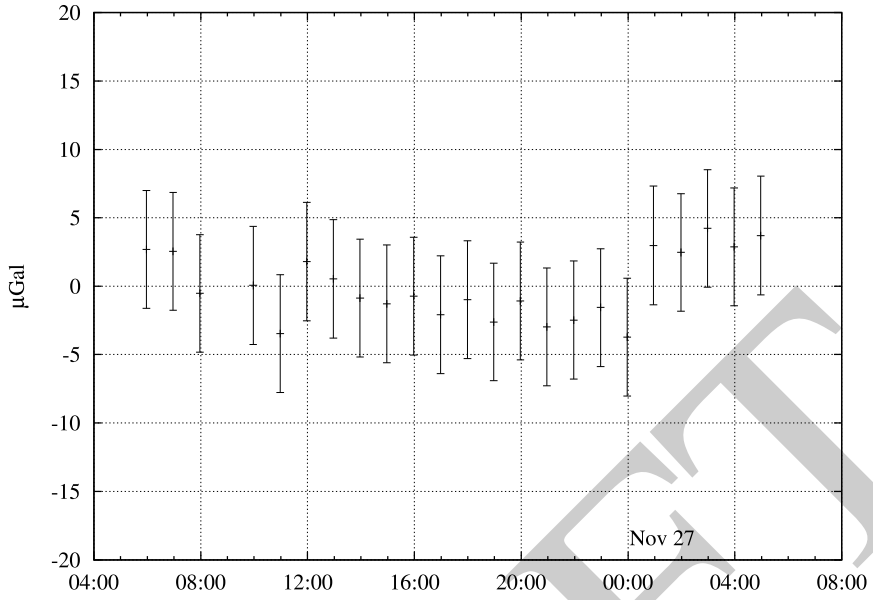

Figure 4.2: AG time series at ground level at ROBE Station. Time is UT. The resulting AG value is given in Table 4.2.

Table 4.2: AG at ROBE Station at ground level and 1 m above ground.

Year	Reference	Altitude above ground (m)	g (μGal)
1997	Mäkinen et al. 2007	0	982 905 922.7
2015	This report	0	982 905 933.79 $\pm$ 4.31
2015	This report	1	982 905 613.79 $\pm$ 2.13

4.2 Gravity link to CRN2 benchmark

The LINZ CRN2 benchmark (Fig. 4.2 in Report I and Table 4.3), also known as ROB4 benchmark, is sealed in a rock near the tide gauge and permanent GPS station. We conducted RG observations on 28 November 2015. We remind the reader that the value given in Table 4.4 for the 2009 observations should be taken with caution.

Table 4.3: Geographical coordinates of CRN2 station

Station	Latitude (°)	Longitude (°)	Elevation (m)
CRN2	77.034 S	163.1902 E	14.6

Table 4.4: Gravity at CRN2 station.

Year	Reference	Type of measurement	g (μGal)
2009	Report I	Tie to THIEL Station (MCM)	982 903 926 $\pm$ 20
2015	This report	Tie to ROBE Station	982 903 890 $\pm$ 5

Chapter 5

Mario Zucchelli Station (I)

As in 2011, we have conducted AG observations at both the TNB AB and IAGS stations (Fig. 5.1 in Report I). Their geographical coordinates are given in Table 5.1. We have tied the IAGS and IRGS stations to TNB AB. For the first time, we have tied a mark close to the GPS permanent station TNB1 to TNB AB. From now on, the IRGS mark will be named IRGS-A and the newly tied mark close to TNB1 will be named IRGS-B.

Table 5.1: Geographical coordinates of and vertical gravity gradient at TNB AB and IAGS stations. Elevation and gravity gradient given by Sasagawa et al. (2004) for TNB AB and by Cerutti at al. (1992) for IAGS.

Station	Latitude (°)	Longitude (°)	Elevation (m)	dg/dz (μGal/cm)
TNB AB	74.6933 S	164.0997 E	30	-3.120 $\pm$ 0.030
IAGS	74.6934 S	164.0998 E	54.3	-3.570 $\pm$ 0.050

5.1 AG at TNB AB Station

This was the fifth AG measurement at TNB AB (Fig. 5.2 in Report I and Fig. 5.1 in Report II). Previous measurements had taken place in 1995 (Sasagawa 2004), 1997 (Mäkinen et al. 2007), 2009 (Report I) and 2011 (Report II). The data providing the AG value given in Table 5.2 were recorded from 1 to 3 December 2015 (local time). Sets of 100 drops were hourly repeated. Fig. 5.1 shows the 48 AG values at the ground level, with their error bars. The mean gravity values measured in 1995, 1997, 2009 and 2011 at the ground level and 1 m above ground are also given in Table 5.2.

The vertical gravity gradient has been measured on 24 November 2009 and 6 December 2015. Its value was -3.047 $\pm$ 0.030 μGal/cm in 2009 and -3.015 $\pm$ 0.028 μGal/cm in 2015. However, we have used the gradient estimated from data given by Cerutti et al. (1992) and given in Table 5.1 to process the 2009, 2011 and 2015 AG observations.

5.2 AG at IAGS Station

The hut of the Italian Absolute Gravity Station (IAGS) contains two pillars (Fig. 5.4 in Report I and Fig. 5.3 in Report II) but only one pillar (Fig. 5.5 in Report I) has been occupied with absolute gravimeters. A tie to TNB AB has, however, been made in 2009 and 2011 and has again been made on 5 December 2015 (Table 5.3). We have run AG observations on this pillar from 5 until 7 December 2015 (local time). Sets of 100 drops were hourly repeated (Fig. 5.2).

Table 5.2: AG measured with FG5 meters at TNB AB station at ground level and 1 m above ground. The 1995 value given by Sasagawa et al. (2004) has been corrected back by Mäkinen et al. (2007) for both Earth tides and instrumental factors. So, the same corrections have been applied to Sasagawa et al.'s data and our data, which allows for a comparison of the gravity values.

Year	Reference	Altitude above ground (m)	g (μGal)
1995	Mäkinen et al. 2007	1	982 865 664.1 $\pm$ 2.1
1997	Mäkinen et al. 2007	1	982 865 663.4
2009	Report I	0	982 865 966.18 $\pm$ 4.33
2009	Report I	1	982 865 654.18 $\pm$ 2.09
2011	Report II	0	982 865 970.21$\pm$ 4.37
2011	Report II	1	982 865 658.21$\pm$ 2.12
2015	This report	0	982 865 966.78 $\pm$ 4.35
2015	This report	1	982 865 654.78 $\pm$ 2.10

The vertical gravity gradient has been measured on 8 December 2011 and 2015. Its value was -3.737 $\pm$ 0.022 μGal/cm in 2011 and -3.653 $\pm$ 0.057 μGal/cm in 2015. However, we have used the gradient estimated from data given by Cerutti et al. (1992) and given in Table 5.1 to process the 2011 and 2015 AG observations.

Table 5.3: AG at IAGS station.

Year	Reference	Type of measurement	Altitude above ground (m)	g (μGal)
1990	Cerutti et al. (1992)	Direct (IMGC meter)	0	982 855 244 $\pm$ 7
2009	Report I	Tie to TNB AB	0	982 855 317 $\pm$ 12
2011	Report II	Tie to TNB AB	0	982 855 317 $\pm$ 12
2015	This report	Tie to TNB AB	0	982 855 331 $\pm$ 8
2011	Report II	Direct (FG5 meter)	0	982 855 316.84 $\pm$ 4.39
2011	Report II	Direct (FG5 meter)	1	982 854 959.84 $\pm$ 2.14
2015	This report	Direct (FG5 meter)	0	982 855 315.95 $\pm$ 4.38
2015	This report	Direct (FG5 meter)	1	982 854 958.95 $\pm$ 2.12

5.3 Gravity links to IRGS-A and IRGS-B stations

The IRGS-A station (Fig. 5.6 in Report I and Fig. 5.5 in Report II) has been tied to TNB AB on 9 December 2015. For the first time, a benchmark, which we named IRGS-B and is sealed near the TNB1 permanent GPS station (Fig. 5.3), has been tied to TNB AB on 11 December 2015. The gravity values at both IRGS-A and IRGS-B are given in Table 5.4.

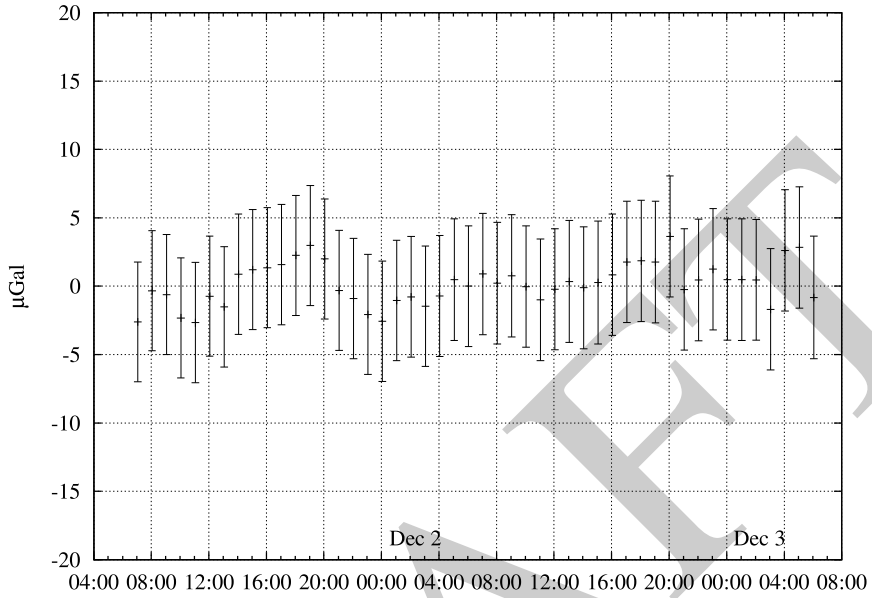

Figure 5.1: AG time series at ground level at TNB AB station. Time is UT. The resulting AG value is given in Table 5.2.

Table 5.4: Gravity ties to IRGS-A and IRGS-B stations.

Year	Reference	Tied station	Reference station	g (μGal)
1990	Cerutti et al. 1992	IRGS-A	IAGS	982 863 890 $\pm$ 33
1995	Sasagawa 2004	IRGS-A	TNB AB	982 863 935 $\pm$ 13
2009	Report I	IRGS-A	TNB AB	982 863 951 $\pm$ 12
2011	Report II	IRGS-A	TNB AB	982 863 947 $\pm$ 6
2015	This report	IRGS-A	TNB AB	982 863 953 $\pm$ 7
2015	This report	IRGS-B	TNB AB	982 842 484 $\pm$ 11

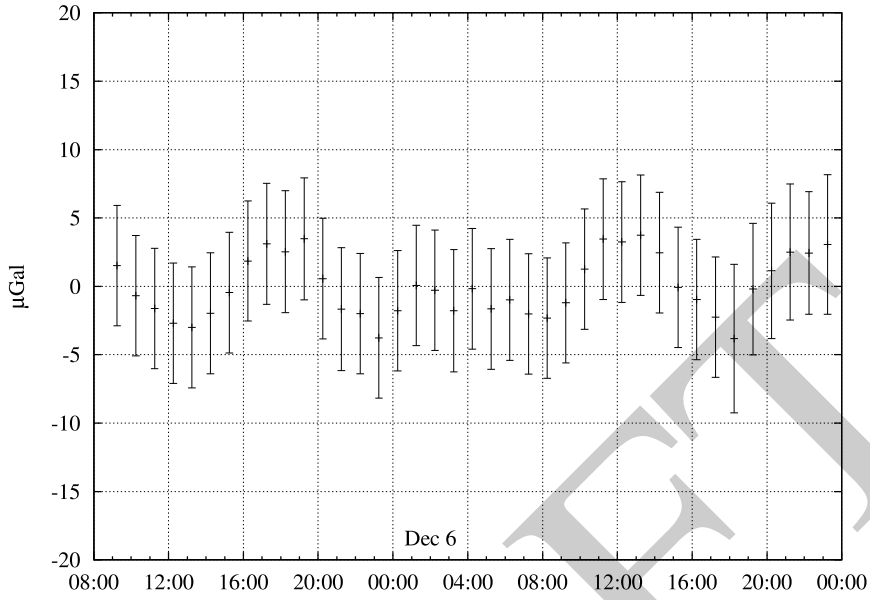

Figure 5.2: AG time series at ground level at IAGS station. Time is UT. The resulting AG value is given in Table 5.3.

Figure 5.3: TNB1 permanent GPS station (top) and IRGS-B benchmark (bottom).

Chapter 6

Conclusions

Despite the cancellation of the observation at DDU, the gravity survey described in this report has been very successful. AG observations have been repeated at THIEL station (MCM), SBG1 station (SB), TNB AB and IAGS stations (MZS). We have also measured the AG at ROBE station at Cape Roberts, where it had been measured for the first time with a FG5 meter in 1997.

Various stations have been tied with a Scintrex CG5 relative gravimeter to the AG reference stations: THIEL-2 station, Hut Point and Radarsat Building (MCM), Seismic Hut (SB), CRN2 (CR), and IAGS, IRGS-A and IRGS-B stations (MZS).

Fig. 6.1 shows the AG values measured at MCM, SB, CR and MZS during the 2009, 2011 and 2015 campaigns, as well as values previously obtained at the same and other (DDU) stations. The 2009 value at IAGS (Section 5.2) has been obtained from a tie to TNB AB, which explains the large error bar. In this plot, it is the only observation that has not been made with an absolute gravimeter.

Table 6.1: Reference gravity values g_0 (in μGal = 10^{-8} m/s^2) for Fig. 6.1.

MZS (TNB AB)	982 865 600
MZS (IAGS)	982 855 230
MCM (THIEL)	982 970 200
SB	982 977 550
DDU	982 387 100
CR	982 905 600

The observations made during the 2009, 2011 and 2015 campaigns are contained in the table of Appendix G.

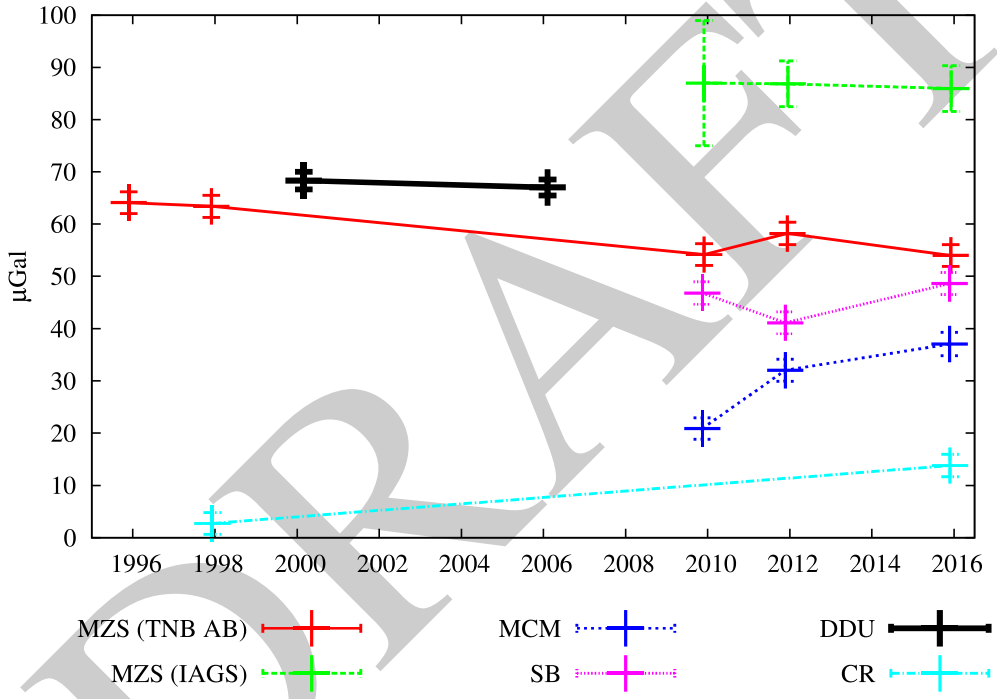

Figure 6.1: Difference (in μGal = 10^{-8} m/s^2) between the actual gravity and g_0 given in Table 6.1 at the 5 stations occupied during the 2009, 2011 and 2015 campaigns (THIEL, SBG1, TNB AB, IAGS, ROBE). Gravity values at DDU station are also plotted.

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Appendix A

List of Acronyms

AG	Absolute Gravity
ANZ	Antarctica New Zealand
CR	Cape Roberts
DDU	Dumont d'Urville
IAGS	Italian AG Station
INSU	Institut National des Sciences de l'Univers
IPEV	Institut Paul-Emile Victor
IRGS	Italian RG Station
JDB	Jean-Daniel Bernard
JOB	James O'Brien
LH	Larry Hothem
LINZ	Land Information New Zealand
MA	Matt Amos
MCM	MCMurdo Station
MZS	Mario Zucchelli Station
NSF	National Science Foundation
PG	Paula Gentle
PNRA	Programma Nazionale di Ricerche in Antartide
POLENET	Polar Earth Observing Network
RG	Relative Gravity
SB	Scott Base
STS	Satellite Triangulation Station
TNB	Terra Nova Bay
USAP	US Antarctic Program
USGS	US Geological Survey
YR	Yves Rogister

Appendix B

Web sites

ANZ	http://www.antarcticanz.govt.nz/
INSU	http://www.insu.cnrs.fr/
IPEV	http://www.institut-polaire.fr/
LINZ	http://www.linz.govt.nz/
PNRA	http://www.pnra.it/
POLENET	http://www.polenet.org/
USAP	http://www.usap.gov/
USGS	http://www.usgs.gov/

Appendix C

Gravity stations

ID	Location	Specified full name	Stamping on Mark	Lat (° S)	Long (° E)	H (m)	g meter
AHGS	MCM	Arrival Heights Gravity Station 2009		77.8389	166.6681	153.0	CG-5
CRN2	CR	Cape Roberts Gravity Station	C ROBERTS NO 2 DEPT OF SURVEY AND LAND INFORMATION SURVEY MARKING	77.0340	163.1902	14.6	CG-5
DDU	DDU	Dumont d'Urville Gravity Station 1999		66.67	140.17	35	FG5
DEVI-AG	FLM	Deverell Island Gravity Station 2011		77.5327	162.5647	125	A10 + CG-5
FLM5-AG	FLM	Mount Fleming Gravity Station 2011			160.2714	1868	A10 + CG-5
IAGS	MZS	IAGS 1990-1991	CNR-ENEA BASE GRAVIMETRICA ABSOLUTA 1990-1991 1st di Metrologia (IMGC)	74.6934	164.0998	54.3	FG5 + CG-5
IRGS-A	MZS	GRAVIMETRIC BASE STATION POINT: A 1987-1988	GRAVIMETRIC BASE STATION POINT: A ENEA-PROGETTO ANTARTIDE-ITALY 3rd ITALIAN ANTARCTIC EXPEDITION 1987/88				CG-5
IRGS-B	MZS	GRAVIMETRIC BASE STATION POINT: B					CG-5
MMD-N	SB	USAF GRAVITY STATION	USAF GRAVITY STATION	77.8491	166.7567	33.2	CG-5
ROBE	CR	Cape Roberts Absolute Gravity Station 1997	C ROBERTS GEODETIC DEPT OF SURVEY AND LAND INFORMATION SURVEY MARKING	77.0350	163.1792	2.8	FG5 + A10 + CG-5
SATGRAV	MCM Bldg 57 (Destroyed in 2003)	SATGRAV POSITION 1991-1992	SATGRAV POSITION 1991-1992 U.S. GEOLOGICAL SURVEY				FG5 + ?
SBG1	SB	Scott Base Absolute Gravity Station	SBG1 LAND INFORMATION NZ SURVEY MARK	77.8489	166.7691	9.1	FG5 + CG-5
STS53	MCM	INTERNATIONAL SATELLITE TRIANGULATION STATION NO. 053 (STS 53) 1969 and Hut Point Gravity Station	BC-4 1969 053 INTERNATIONAL SATELLITE TRIANGULATION STATION NO. 053				CG-5
THIEL	MCM Bldg 146	THIEL GRAVITY BASE STATION 2000-2001	THIEL 2000-2001	77.8490	166.6794	46.21	FG5 + CG-5
THIEL-2	MCM	THIEL-2 GRAVITY BASE STATION 2000-2001					CG-5
TNB AB	MZS	TERRA NOVA BAY AB 1995		74.6933	164.0997	30	FG5 + CG-5

Appendix D

Campaign Planning

Antarctica Absolute Gravity (AG) Measurements Project
2015-16 Field Season
Chronology of proposed schedule of events

7 September 2015 (v2)

NOTE 1: The following dates are approximate with many factors affecting what may be the actual dates.

NOTE 2: Logistical support for occupation of AG station **SBG-1** at Scott Base (SB) and AG station **ROB0** at Cape Roberts (CR) is provided by AntNZ, and will be coordinated through Matt Amos, Land Information NZ (LINZ), in accordance with AntNZ project event K150. Matt will be based at Scott Base (SB). The logistical support includes huts with power for occupation of **SBG-1** at SB and station **ROB0** at CR. Additional support includes camping gear for the multiple day deployment of the AG team at Cape Roberts.

NOTE 3: The plan is to occupy and conduct absolute gravity (AG) measurements with the FG-5 instrument on a total of six stations: **THIEL** at MCM, **SBG-1** at Scott Base (SB), **ROB0** at Cape Roberts (CR), **TNB AB 1995** at MZS, **IAGS 1990-1991** at MZS, and gravity station **DDU** at Dumont d'Urville (DDU).

Activity	Approximate Start Date(s)	Approximate Ending Date(s)	Transport	Comments
FG-5 arrives in Christchurch from France	12 Nov. 2015	13 Nov. 2015	Commercial Aircraft	Per present schedule, FG-5 shipped from France. Dates updated early October.
Y. Rogister and J-D Bernard, French FG-5 team, arrive in CHC	12 Nov. 2015	13 Nov. 2015	Commercial Aircraft	Arrival in CHC coordinated with estimated date for arrival of FG-5 cargo in CHC.
L. Hothem, Project Coordinator, arrives in CHC	13 Nov. 2015	14 Nov 2015	Commercial Aircraft	
FG-5 transported to MCM	Nov 2015	14 Nov 2015	C-17	Based on request in SIP for G-079-M
L. Hothem, Y. Rogister and J-D Bernard, transported to MCM	16 Nov. 2015	16 Nov 2015	C-17	Per schedule provided by T. Wilson & D. Saddler
Unpack, test and calibrate FG-5	17 Nov. 2015	19 Nov. 2015	- -	
As appropriate, all participate in briefings, orientation & in FSTP training	17 Nov. 2015	20 Nov. 2015	- -	
Occupy AG station **THIEL** at MCM with FG-5	19 Nov. 2015	21 Nov. 2015	- -	The desired period for the measurements is continuous for 48 hours.
Transport FG-5 to AG Station **SBG-1** at SB	21 Nov. 2015	22 Nov. 2015	Truck from MCM pool	**NOTE:** should transport & setup be done on Sun., 22 Nov., required is coordination on Sat., 21 Nov. with K150 AntNZ
Occupy **SBG-**1 with FG-5	22 Nov. 2015	24 Nov. 2015	- -	The desired period for the measurements is continuous for 48 hours.

Prepare FG-5 for transport to AG station at CR	24 Nov. 2015	25 Nov. 2015	- -	
Transport FG-5 and personnel from SB to CR	25 Nov. 2015	26 Nov. 2015	Via helicopter provided by AntNZ in coordination with event K150 & LINZ	Unpack, test and setup the FG-5; multiple day deployment involves camping at Cape Roberts.
Occupy AG station **ROB** at CR with FG-5	26 Nov 2015	29 Nov. 2015	- -	The desired period for the measurements is continuous for 48 hours.
Transport FG-5 and personnel from CR to SB	30 Nov. 2015	30 Nov. 2015	Via helicopter provided by AntNZ in coordination with K150 & LINZ	
Prepare FG-5 for shipment to Mario Zucchelli Station (MZS)	30 Nov. 2015	1 Dec. 2015	- -	
FG-5 & personnel (Hothem, Rogister and Bernard) transported to MZS	1 Dec. 2015	2 Dec. 2015	USAP Twin O	
At MZS: test & calibrate FG-5 and occupy 1st AG station **TNB AB 1995**	3 Dec. 2015	5 Dec. 2015	- -	The desired period for the measurements is continuous for 48 hours.
Transport FG-5 to 2nd AG station **IAGS 1990-1991**	6 Dec. 2015	6 Dec. 2015	MZS	
Occupy 2nd AG station **IAGS 1990-1991**	6 Dec. 2015	7 Dec. 2015	- -	
Prepare FG-5 for shipment to Dumont d'Urville (DDU)	7 Dec. 2015	8 Dec. 2015		
Transport FG-5 meter and AG team from MZS to Dumont d'Urville (DDU)	8 Dec. 2015	12 Dec. 2015	Transport provided by IPEV	Target dates based on current IPEV schedule for air transport from MZS to DDU, and ship transport from DDU to Hobart.
At DDU, unpack, test and calibration of FG-5	8 Dec. 2015	12 Dec 2015	- -	
Occupy AG station at DDU with FG-5	13 Dec. 2015	2015	- -	The desired period for the measurements is continuous for 48 hours.
Prepare for transport: FG-5 and personnel (3) from DDU to Hobart, Tasmania	15 Dec. 2015	16 Dec. 2015	- -	
Transport FG-5 and personnel from DDU to Hobart, Tasmania	17 Dec. 2015	23 Dec. 2015	Shipped by L'ASTROLABE	Based on current schedule for the L'ASTROLABE provided by IPEV
Transport FG-5 cargo and personnel to home bases	28 Dec. 2015	- -	Commercial Aircraft	

Appendix E

Field Event Log

Local time is UT + 13. Because of this time difference, dates may be different from the dates in the text.

16 Nov JDB, LH and YR arrive at MCM, PG, MA and JOB arrive at SB

17 Nov Equipment delivered at the Crary Lab. Start vacuum pump.

18 Nov AM Visit of the hut at SB. PM FG5 set up at Thiel hut.

19 Nov Start AG measurements at Thiel hut.

21 Nov AM Meeting at SB to plan transportation to and stay at CR. PM Stop AG measurements at Thiel hut. Move FG5 to SB. FG5 set up over SBG1. Start AG measurements.

23 Nov AM THIEL-2 tied to THIEL with Scintrex CG5. PM Dismount FG5 at SB. FG5 packed and ready to be transported to CR.

24 Nov AM Radarsat building tied to THIEL. PM SBG1 and Seismic Hut station at SB tied to THIEL. PG and MA transported to CR to set up the tent.

25 Nov AM JOB, LH, JDB and YR transported to CR. PM Return of PG and MA to SB. FG5 set up over ROBE.

26 Nov Start AG measurements at ROBE.

27 Nov At 5 AM, the heater stops in the tent, probably because of the wind.

28 Nov PM Stop AG measurements. Vertical gradient.

29 Nov CRN2 tied to ROBE.

30 Nov Team and equipment transported back to MCM.

01 Dec AM Equipment, LH, JDB and YR transported to MZS on a Basler. Arrive at 10 AM. PM FG5 set up at TNB AB. 6 PM Start AG measurements.

03 Dec AM PG, JOB and MA fly to ChC, NZ. 8 PM Stop AG measurements at TNB AB.

04 Dec FG5 set up at IAGS.

05 Dec AM Need to make vacuum in the dropping chamber.

06 Dec Vertical gradient at TNB AB. Tie IAGS to TNB AB. 7 PM Start AG measurements at IAGS.

07 Dec 4 PM. Stop AG measurements at IAGS.

08 Dec Dismount FG5.

09 Dec AM Vertical gradient at IAGS. PM IRGS-A tied to TNB AB.

11 Dec Permanent GPS receiver (IRGS-B) tied to TNB AB.

15 Dec AM Equipment and team transported back to MCM.

18 Dec PM Meeting with Terry Wilson.

19 Dec LH, JDB and YR fly to ChC, NZ.

Appendix F

Set processing log for AG measurements

Ground values are in red, 1-meter above ground values are in blue.

F.1 MCMurdo Station

```
Micro-g LaCoste g Processing Report
g Acquisition Version:  6.060320
g Processing Version:  9.120423

Station Data
Name:  Mac Murdo
Site Code:  THIEL
Lat:  -77.84900 Long:  166.67940 Elev:  46.21 m
Setup Height:  15.40 cm
Transfer Height:  0.00 cm
Actual Height:  131.80 cm

Micro-g Solutions g Processing Report

g Acquisition Version:  6.060320
g Processing Version:  9.120423

Station Data
Name:  MCMurdo
Site Code:  THIEL
Lat:  -77.84900 Long:  166.67940 Elev:  46.21 m
Setup Height:  15.40 cm
Transfer Height:  0.00 cm
Transfer Height:  100.00 cm
Actual Height:  131.80 cm
Gradient:  -3.114 μGal/cm
Nominal Air Pressure:  1007.71 mBar
Barometric Admittance Factor:  0.30
Polar Motion Coord:  0.1346 " 0.2570 "
Earth Tide (ETGTAB) Selected
Potential Filename:  ETCPOT.dat
Delta Factor Filename:  OceanLoad-Mac Murdo.dff
```

Delta Factors
Start Stop Amplitude Phase Term
0.000000 0.000001 1.000000 0.0000 DC
0.000002 0.249951 1.160000 0.0000 Long
0.721500 0.906315 1.154250 0.0000 Q1
0.921941 0.974188 1.154240 0.0000 O1
0.989049 0.998028 1.149150 0.0000 P1
0.999853 1.216397 1.134890 0.0000 K1
1.719381 1.906462 1.161720 0.0000 N2
1.923766 1.976926 1.161720 0.0000 M2
1.991787 2.002885 1.161720 0.0000 S2
2.003032 2.182843 1.161720 0.0000 K2
2.753244 3.081254 1.07338 0.0000 M3
3.791964 3.937897 1.03900 0.0000 M4
Ocean Load ON, Filename: OceanLoad-Mac Murdo.olf
Waves: M2 S2 K1 O1 N2 P1 K2 Q1 Mf Mm Ssa
Amplitude (μGal):
0.673 0.258 1.845 1.488 0.094 0.621 0.069 0.347 0.278 0.219 0.203
Phase (deg):
-329.0 -119.3 -157.0 -145.7 -11.6 -158.9 -149.3 -141.9 -20.6 -11.2 -16.5

Instrument Data
Meter Type: FG5
Meter S/N: 206
Factory Height: 116.20 cm
Rubidium Frequency: 10000000.00000 Hz
Laser: WEO100 (146)
ID: 632.99117754 nm (0.33 V)
IE: 632.99119473 nm (-0.10 V)
IF: 632.99121259 nm (-0.49 V)
IG: 632.99123023 nm (-0.85 V)
IH: 632.99136890 nm (-1.40 V)
II: 632.99139822 nm (-1.18 V)
IJ: 632.99142704 nm (-0.10 V)
Modulation Frequency: 8333.383 Hz

Processing Results
Date: 11/20/15
Time: 02:50:14
DOY: 324
Year: 2015
Time Offset (D h:m:s): 0 0:0:0
Gravity: 982970548.43 μGal
Gravity: 982970237.03 μGal
Set Scatter: 5.17 μGal
Measurement Precision: 0.80 μGal
Total Uncertainty: 4.44 μGal
Total Uncertainty: 2.24 μGal
Number of Sets Collected: 102
Number of Sets Processed: 84

Set #s Processed:
2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,
28,29,30,31,32,33,34,35,37,38,39,40,41,42,43,44
Number of Sets NOT Processed: 2
Set #s NOT Processed: 1, 36
Number of Drops/Set: 100
Total Drops Accepted: 3983
Total Drops Rejected: 217
Total Fringes Acquired: 700
Fringe Start: 30
Processed Fringes: 641
GuideCard Multiplex: 4
GuideCard Scale Factor: 250

Acquisition Settings
Set Interval: 60 min
Drop Interval: 10 sec
Number of Sets: 50
Number of Drops: 100

Gravity Corrections
Earth Tide (ETGTAB): -73.54 μGal
Ocean Load: 0.10 μGal
Polar Motion: -1.50 μGal
Barometric Pressure: -13.67 μGal
Transfer Height: 410.43 μGal
Transfer Height: 99.03 μ Gal
Reference Xo: -0.00 μGal

Uncertainties
Sigma Reject: 3.00
Earth Tide Factor: 0.001
Average Earth Tide Uncertainty: 0.07 μGal
Ocean Load Factor: 0.10
Average Ocean Load Uncertainty: 0.01 μGal
Barometric: 1.00 μGal
Polar Motion: 0.05 μGal
Laser: 0.05 μGal
Clock: 0.50 μGal
System Type: 1.10 μGal
Tidal Swell: 0.00 μGal
Water Table: 0.00 μGal
Unmodeled: 0.00 μGal
System Setup: 1.00 μGal
Gradient: 3.954 μGal (0.03 μGal/cm)
Gradient: 0.954 μGal (0.03 μGal/cm)

F.2 Scott Base

```
g Acquisition Version:  6.060320
g Processing Version:  9.120423

Station Data
Name:  Scott Base
Site Code:  SBG1
Lat:  -77.84890 Long:  166.76910 Elev:  9.10 m
Setup Height:  15.40 cm
Transfer Height:  0.00 cm
Transfer Height:  100.00 cm
Actual Height:  131.80 cm
Gradient:  -3.491 μGal/cm
Nominal Air Pressure:  1012.16 mBar
Barometric Admittance Factor:  0.30
Polar Motion Coord:  0.1605 " 0.2841 "
Earth Tide (ETGTAB) Selected
Potential Filename:  ETCPOT.dat
Delta Factor Filename:  OceanLoad-Scott Base.dff
Delta Factors
Start Stop Amplitude Phase Term
0.000000 0.000001 1.000000 0.0000 DC
0.002428 0.249951 1.160000 0.0000 Long
0.721500 0.906315 1.154250 0.0000 Q1
0.921941 0.974188 1.154240 0.0000 O1
0.989049 0.998028 1.149150 0.0000 P1
0.999853 1.216397 1.134890 0.0000 K1
1.719381 1.906462 1.161720 0.0000 N2
1.923766 1.976926 1.161720 0.0000 M2
1.991787 2.002885 1.161720 0.0000 S2
2.003032 2.182843 1.161720 0.0000 K2
2.753244 3.081254 1.07338 0.0000 M3
3.791964 3.937897 1.03900 0.0000 M4
Ocean Load ON, Filename:  OceanLoad-SBG1.olf
Waves:  M2 S2 K1 O1 N2 P1 K2 Q1 Mf Mm Ssa
Amplitude (μGal):
0.674 0.259 1.852 1.493 0.094 0.624 0.069 0.348 0.278 0.220 0.204
Phase (deg):
-329.2 -119.6 -157.1 -145.7 -12.1 -158.9 -149.5 -141.9 -20.6 -11.2 -16.5

Instrument Data
Meter Type:  FG5
Meter S/N: 206 Factory Height:  116.40 cm
Rubidium Frequency:  10000000.00000 Hz
Laser:  WEO100 (146)
ID: 632.99117754 nm ( 0.53 V)
IE: 632.99119473 nm ( -0.15 V)
IF: 632.99121259 nm ( -0.83 V)
IG: 632.99123023 nm ( -0.92 V)
```

IH: 632.99136890 nm (-1.52 V)
II: 632.99139822 nm (-1.30 V)
IJ: 632.99142704 nm (-1.10 V)
Modulation Frequency: 8333.383 Hz

Processing Results
Date: 11/22/15
Time: 00:52:19
DOY: 326
Year: 2015
Time Offset (D h:m:s): 0 0:0:0
Gravity: 982977947.71μGal
Gravity: 982977598.61μGal
Set Scatter: 1.59 μGal
Measurement Precision: 0.26 μGal
Total Uncertainty: 4.38 μGal
Total Uncertainty: 2.11 μGal
Number of Sets Collected: 38
Number of Sets Processed: 38
Set #s Processed: 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,
24,25,26,27,28,29,30,31,32,33,34,35,36,37,38
Number of Sets NOT Processed: 0
Number of Drops/Set: 100
Total Drops Accepted: 3618
Total Drops Rejected: 182
Total Fringes Acquired: 700
Fringe Start: 30
Processed Fringes: 641
GuideCard Multiplex: 4
GuideCard Scale Factor: 250

Acquisition Settings
Set Interval: 60 min
Drop Interval: 10 sec
Number of Drops: 100

Gravity Corrections
Earth Tide (ETGTAB): -80.50 μGal
Ocean Load: 0.41 μGal
Polar Motion: -1.46μGal
Barometric Pressure: -10.79 μGal
Transfer Height: 460.11 μGal
Transfer Height: 111.01 μGal
Reference Xo: -0.00 μGal

Uncertainties
Sigma Reject: 3.00
Earth Tide Factor: 0.001
Average Earth Tide Uncertainty: 0.08 μGal
Ocean Load Factor: 0.10

Average Ocean Load Uncertainty: 0.04 μGal
Barometric: 1.00 μGal
Polar Motion: 0.05 μGal
Laser: 0.05 μGal
Clock: 0.50 μGal
System Type: 1.10 μGal
Tidal Swell: 0.00 μGal
Water Table: 0.00 μGal
Unmodeled: 0.00 μGal
System Setup: 1.00 μGal
Gradient: 3.954 μGal (0.030 μGal/cm)
Gradient: 0.954 μGal (0.03 μGal/cm)

F.3 Cape Roberts

```
g Acquisition Version:  6.060320
g Processing Version:  9.120423

Station Data
Name:  Cape Roberts
Site Code:  Robe-1
Lat:  -77.00350 Long:  163.17920 Elev:  2.80 m
Setup Height:  11.70 cm
Transfer Height:  0.00 cm
Transfer Height:  100.00 cm
Actual Height:  128.10 cm
Gradient:  -3.200 µGal/cm
Nominal Air Pressure:  1012.91 mBar
Barometric Admittance Factor:  0.30
Polar Motion Coord:  0.1196 " 0.2541 "
Earth Tide (ETGTAB) Selected
Potential Filename:  ETCPOT.dat
Delta Factor Filename:  OceanLoad-Cape Roberts.dff
Delta Factors
Start Stop Amplitude Phase Term
0.000000 0.000001 1.000000 0.0000 DC
0.000002 0.249951 1.160000 0.0000 Long
0.721500 0.906315 1.154250 0.0000 Q1
0.921941 0.974188 1.154240 0.0000 O1
0.989049 0.998028 1.149150 0.0000 P1
0.999853 1.216397 1.134890 0.0000 K1
1.719381 1.906462 1.161720 0.0000 N2
1.923766 1.976926 1.161720 0.0000 M2
1.991787 2.002885 1.161720 0.0000 S2
2.003032 2.182843 1.161720 0.0000 K2
2.753244 3.081254 1.07338 0.0000 M3
3.791964 3.937897 1.03900 0.0000 M4
Ocean Load ON, Filename:  OceanLoad-Cape Roberts.olf
Waves:  M2 S2 K1 O1 N2 P1 K2 Q1 Mf Mm Ssa
Amplitude (µGal):
0.625 0.233 1.786 1.461 0.080 0.605 0.068 0.349 0.276 0.220 0.203
Phase (deg):
-316.3 -115.9 -158.9 -148.2 -4.1 -160.4 -147.2 -143.0 -20.2 -10.9 -15.1

Instrument Data
Meter Type:  FG5
Meter S/N: 206 Factory Height:  116.40 cm
Rubidium Frequency:  10000000.00000 Hz
Laser:  WEO100 (146)
ID: 632.99117754 nm ( 1.00 V)
IE: 632.99119473 nm ( 0.00 V)
IF: 632.99121259 nm ( -0.20 V)
IG: 632.99123023 nm ( -0.85 V)
```

IH: 632.99136890 nm (-1.42 V)
II: 632.99139822 nm (-1.00 V)
IJ: 632.99142704 nm (-1.00 V)
Modulation Frequency: 8333.383 Hz

Processing Results
Date: 11/26/15
Time: 17:50:26
DOY: 330
Year: 2015
Time Offset (D h:m:s): 0 0:0:0
Gravity: 982905933.79 μGal
Gravity: 982905613.79μGal
Set Scatter: 2.54 μGal
Measurement Precision: 0.53 μGal
Total Uncertainty: 4.31 μGal
Total Uncertainty: 2.13 μGal
Number of Sets Collected: 27
Number of Sets Processed: 23
Set #s Processed: 4,5,6,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27
Number of Sets NOT Processed: 4
Set #s NOT Processed: 1,2,3,7
Number of Drops/Set: 100
Total Drops Accepted: 1826
Total Drops Rejected: 474
Total Fringes Acquired: 700
Fringe Start: 30
Processed Fringes: 641
GuideCard Multiplex: 4
GuideCard Scale Factor: 250

Acquisition Settings
Set Interval: 60 min
Drop Interval: 10 sec
Number of Drops: 100

Gravity Corrections
Earth Tide (ETGTAB): -54.81 μGal
Ocean Load: 0.03 μGal
Polar Motion: -1.58μGal
Barometric Pressure: -11.30 μGal
Transfer Height: 409.92 μGal
Transfer Height: 89.92 μGal
Reference Xo: -0.00 μGal

Uncertainties
Sigma Reject: 2.00
Earth Tide Factor: 0.001
Average Earth Tide Uncertainty: 0.05 μGal
Ocean Load Factor: 0.10

Average Ocean Load Uncertainty: 0.00 μGal
Barometric: 1.00 μGal
Polar Motion: 0.05 μGal
Laser: 0.01 μGal
Clock: 0.50 μGal
System Type: 1.10 μGal
Tidal Swell: 0.00 μGal
Water Table: 0.00 μGal
Unmodeled: 0.00 μGal
System Setup: 1.00 μGal
Gradient: 3.843 μGal (0.030 μGal/cm)
Gradient: 0.843 μGal (0.03 μGal/cm)

F.4 Mario Zucchelli Station

F.4.1 TNB AB

```
Micro-g Solutions g Processing Report

g Acquisition Version:  6.060320
g Processing Version:  9.120423

Station Data
Name:  Mario Zucchelli Station TNB AB
Site Code:  TNB AB
Lat:  -74.69477 Long:  164.11478 Elev:  30.00 m
Setup Height:  14.70 cm
Transfer Height:  0.00 cm
Transfer Height:  100.00 cm
Actual Height:  130.90 cm
Gradient:  -3.120 µGal/cm
Nominal Air Pressure:  1009.65 mBar
Barometric Admittance Factor:  0.30
Polar Motion Coord:  0.1106 " 0.2536 "
Earth Tide (ETGTAB) Selected
Potential Filename:  OceanLoad-Mario Zucchelli Station TNBAB.dff
Delta Factors
Start Stop Amplitude Phase Term
0.000000 0.000001 1.000000 0.0000 DC
0.000002 0.249951 1.160000 0.0000 Long
0.721500 0.906315 1.154250 0.0000 Q1
0.921941 0.974188 1.154240 0.0000 O1
0.989049 0.998028 1.149150 0.0000 P1
0.999853 1.216397 1.134890 0.0000 K1
1.719381 1.906462 1.161720 0.0000 N2
1.923766 1.976926 1.161720 0.0000 M2
1.991787 2.002885 1.161720 0.0000 S2
2.003032 2.182843 1.161720 0.0000 K2
2.753244 3.081254 1.07338 0.0000 M3
3.791964 3.937897 1.03900 0.0000 M4
Ocean Load ON, Filename:  OceanLoad-Mario Zucchelli Station TNBAB.olf
Waves:  M2 S2 K1 O1 N2 P1 K2 Q1 Mf Mm Ssa
Amplitude (µGal):
0.672 0.304 2.109 1.760 0.057 0.709 0.092 0.423 0.301 0.246 0.224
Phase (deg):
-304.9 -139.0 -161.5 -150.8 -44.0 -162.9 -165.5 -145.5 -20.1 -11.4 -14.8

Instrument Data
Meter Type:  FG5
Meter S/N: 206
Factory Height:  116.40 cm
Rubidium Frequency:  10000000.00000 Hz
Laser:  WEO100 (146)
```

ID: 632.99117754 nm (0.95 V)
IE: 632.99119473 nm (-0.38 V)
IF: 632.99121259 nm (-0.20 V)
IG: 632.99123023 nm (-0.30 V)
IH: 632.99136890 nm (-0.40 V)
II: 632.99139822 nm (-1.18 V)
IJ: 632.99142704 nm (-0.10 V)
Modulation Frequency: 8333.383 Hz

Processing Results
Date: 12/02/15
Time: 06:33:23
DOY: 336
Year: 2015
Time Offset (D h:m:s): 0 0:0:0
Gravity: 982865966.78 μGal
Gravity: 982865654.78μGal
Set Scatter: 1.61 μGal
Measurement Precision: 0.23 μGal
Total Uncertainty: 4.35 μGal
Total Uncertainty: 2.10 μGal
Number of Sets Collected: 50
Number of Sets Processed: 48
Set #s Processed: 3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,
25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50
Number of Sets NOT Processed: 2
Set #s NOT Processed: 1, 2
Number of Drops/Set: 100
Total Drops Accepted: 4541
Total Drops Rejected: 259
Total Fringes Acquired: 700
Fringe Start: 30
Processed Fringes: 641
GuideCard Multiplex: 4
GuideCard Scale Factor: 250

Acquisition Settings
Set Interval: 60 min
Drop Interval: 10 sec
Number of Sets: 44
Number of Drops: 100

Gravity Corrections
Earth Tide (ETGTAB): -54.33 μGal
Ocean Load: -0.31 μGal
Polar Motion: -1.71 μGal
Barometric Pressure: -8.66 μGal
Transfer Height: 408.41 μGal
Transfer Height: 96.41 μGal
Reference Xo: -0.00 μGal

```
Uncertainties
Sigma Reject:  3.00
Earth Tide Factor:  0.001
Average Earth Tide Uncertainty:  0.05 μGal
Ocean Load Factor:  0.10
Average Ocean Load Uncertainty:  0.03 μGal
Barometric:  1.00 μGal
Polar Motion:  0.05 μGal
Laser:  0.01 μGal
Clock:  0.50 μGal
System Type:  1.10 μGal
Tidal Swell:  0.00 μGal
Water Table:  0.00 μGal
Unmodeled:  0.00 μGal
System Setup:  1.00 μGal
Gradient:  3.927 μGal (0.03 μGal/cm)
Gradient:  0.927 μGal (0.03 μGal/cm)
```

F.4.2 IAGS

```
Micro-g Solutions g Processing Report

g Acquisition Version:  6.060320
g Processing Version:  9.120423

Station Data
Name:  Mario Zucchelli Station IAGS
Site Code:  IAGS
Lat:  -74.69340 Long:  164.09980 Elev:  54.30 m
Setup Height:  15.20 cm
Transfer Height:  0.00 cm
Transfer Height:  100.00 cm
Actual Height:  131.60 cm
Gradient:  -3.570 μGal/cm
Nominal Air Pressure:  1006.74 mBar
Barometric Admittance Factor:  0.30
Polar Motion Coord:  0.1050 " 0.2523 "
Earth Tide (ETGTAB) Selected
Potential Filename:  ETCPOT.dat
Delta Factor Filename:  OceanLoad-iags Mario Zuccelli Station.dff
Delta Factors
Start Stop Amplitude Phase Term
0.000000 0.000001 1.000000 0.0000 DC
0.002428 0.249951 1.160000 0.0000 Long
0.721500 0.906315 1.154250 0.0000 Q1
0.921941 0.974188 1.154240 0.0000 O1
0.989049 0.998028 1.149150 0.0000 P1
0.999853 1.216397 1.134890 0.0000 K1
1.719381 1.906462 1.161720 0.0000 N2
```

1.923766 1.976926 1.161720 0.0000 M2
1.991787 2.002885 1.161720 0.0000 S2
2.003032 2.182843 1.161720 0.0000 K2
2.753244 3.081254 1.07338 0.0000 M3
3.791964 3.937897 1.03900 0.0000 M4
Ocean Load ON, Filename: OceanLoad-iags Mario Zuccelli Station.olf
Waves: M2 S2 K1 O1 N2 P1 K2 Q1 Mf Mm Ssa
Amplitude (μGal):
0.672 0.304 2.108 1.760 0.057 0.709 0.092 0.423 0.301 0.246 0.224
Phase (deg):
-304.9 -139.0 -161.5 -150.8 -44.0 -162.9 -165.5 -145.5 -20.1 -11.4 -14.8

Instrument Data
Meter Type: FG5
Meter S/N: 206
Factory Height: 116.20 cm
Rubidium Frequency: 10000000.00000 Hz
Laser: WEO100 (146)
ID: 632.99117754 nm (0.40 V)
IE: 632.99119473 nm (-0.13 V)
IF: 632.99121259 nm (-0.60 V)
IG: 632.99123023 nm (1.10 V)
IH: 632.99136890 nm (-1.47 V)
II: 632.99139822 nm (-1.28 V)
IJ: 632.99142704 nm (-1.10 V)
Modulation Frequency: 8333.383 Hz

Processing Results
Date: 12/06/15
Time: 02:44:53
DOY: 340
Year: 2015
Time Offset (D h:m:s): 0 0:0:0
Gravity: 982855315.95 μGal
Gravity: 982854958.95 μGal
Set Scatter: 2.11 μGal
Measurement Precision: 0.33 μGal
Total Uncertainty: 4.38 μGal
Total Uncertainty: 2.12 μGal
Number of Sets Collected: 45
Number of Sets Processed: 42
Set #s Processed: 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,
23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42
Number of Sets NOT Processed: 3
Set #s NOT Processed: 43,44,45
Number of Drops/Set: 100
Total Drops Accepted: 3966
Total Drops Rejected: 234
Total Fringes Acquired: 700
Fringe Start: 30

Processed Fringes: 641
GuideCard Multiplex: 4
GuideCard Scale Factor: 250

Acquisition Settings
Set Interval: 60 min
Drop Interval: 10 sec
Number of Drops: 100

Gravity Corrections
Earth Tide (ETGTAB): -55.72 μGal
Ocean Load: -0.13 μGal
Polar Motion: -1.66 μGal
Barometric Pressure: -8.40 μGal
Transfer Height: 469.81 μGal
Transfer Height: 112.81 μGal
Reference Xo: -0.00 μGal

Uncertainties
Sigma Reject: 3.00
Earth Tide Factor: 0.001
Average Earth Tide Uncertainty: 0.06 μGal
Ocean Load Factor: 0.10
Average Ocean Load Uncertainty: 0.01 μGal
Barometric: 1.00 μGal
Polar Motion: 0.05 μGal
Laser: 0.05 μGal
Clock: 0.50 μGal
System Type: 1.10 μGal
Tidal Swell: 0.00 μGal
Water Table: 0.00 μGal
Unmodeled: 0.00 μGal
System Setup: 1.00 μGal
Gradient: 3.948 μGal (0.03 μGal/cm)
Gradient: 0.948 μGal (0.03 μGal/cm)

Appendix G

Summary Table of g observations

Location	Station	Lat (° S)	Long (° E)	Elevation (m)	dg/dz (μGal/cm)	Date	Instrument	Height (m)	g (μGal)
McMurdo	THIEL	77.8490	166.6794	46.21	-3.114 ± 0.030	11-14/11/09	FG5	0	982 970 532.28 ± 4.30
								1	982 970 220.88 ± 2.07
						21-23/11/11		0	982 970 543.42 ± 4.39
								1	982 970 232.02 ± 2.14
						19-21/11/15		0	982 970 548.43 ± 4.44
								1	982 970 237.03 ± 2.24
						19/11-7/12/11	A10	0	982 970 522 ± 11
	THIEL-2			–	–	27/11/11	CG5	0	982 970 903 ± 7
						23/11/15		0	982 970 871.1 ± 8.6
	Hut Point	77.8448	166.6418	17.6	–	27/11/09	CG5	0	982 975 754 ± 15
						23/11/15		0	982 975 783 ± 15
	Radarsat	–	–	–	–	27/11/09		0	982 945 942 ± 15
						24/11/15		0	982 945 988 ± 9
						29/11/11	A10	0	982 945 926 ± 11
Mount Fleming	FLM5	77.5327	160.2714	1868	–	03/12/11	CG5	0	982 442 236 ±11
							A10	0	982 442 325 ±11
Scott	SBG1	77.8489	166.7691	9.1	-3.491 ± 0.030	17-18/11/09	FG5	0	982 977 945.91 ± 4.34
								1	982 977 596.81 ± 2.15
						27/11/09	CG5	0	982 977 946 ± 15
						02-03/12/11	FG5	0	982 977 940.22 ± 4.32
								1	982 977 591.12 ± 2.10
						21-23/11/15	FG5	0	982 977 947.71 ± 4.38
								1	982 977 598.61 ± 2.11
						20/11-09/12/11	A10	0	982 977 944 ± 11
	MMD-N	77.8491	166.7567	33.2	–	27/11/09	CG5	0	982 973 537 ± 15
						24/11/15		0	982 973 533 ± 12
Cape Roberts	ROBE	77.0035	163.1792	2.8	–	18/11/09		0	982 905 984 ± 20
						20/11/09		0	982 905 914 ± 21
						30/11/11	A10	0	982 905 926 ± 11
						25-28/11/11	FG5	0	982 905 933.79 ± 4.31
								1	982 905 613.79 ± 2.13
	CRN2	77.0034	163.1902	14.6	–	18/11/09	CG5	0	982 903 926 ± 20
						28/11/15		0	982 903 890 ± 5

		(° S)	(° E)	(m)	(μGal/cm)			(m)	(μGal)
Location	Station	Lat	Long	Elevation	dg/dz	Date	Instrument	Height	g
Mario Zucchelli	TNB AB	74.6933	164.0997	30	-3.12 $\pm$ 0.03	21-22/11/09	FG5	0	982 865 966.18 $\pm$ 4.33
								1	982 865 654.18 $\pm$ 2.09
						07-09/12/11		0	982 865 970.21$\pm$ 4.37
								1	982 865 658.21$\pm$ 2.12
						1-3/12/15		0	982 865 966.78 $\pm$ 4.35
								1	982 865 654.78 $\pm$ 2.10
	IAGS	74.6934	164.0998	54.3	-3.57 $\pm$ 0.05	21-24/11/09	CG5	0	982 855 317 $\pm$ 12
						08/12/11		0	982 855 317 $\pm$ 12
						10-12/12/11	FG5	0	982 855 316.84 $\pm$ 4.39
								1	982 584 959.84 $\pm$ 2.14
						5-7/12/15	FG5	0	982 855 315.95 $\pm$ 4.38
								1	982 854 958.95 $\pm$ 2.12
	IAGS 2	–	–	–	–	11-12/12/11	CG5	0	982 855 298 $\pm$ 5
	IRGS-A	–	–	–	–	21-24/11/09		0	982 863 951 $\pm$ 12
						10/12/11		0	982 863 947 $\pm$ 6
						9/12/11		0	982 863 953 $\pm$ 7
	IRGS-B	–	–	–	–	11/12/15		0	982 842 484 $\pm$ 11