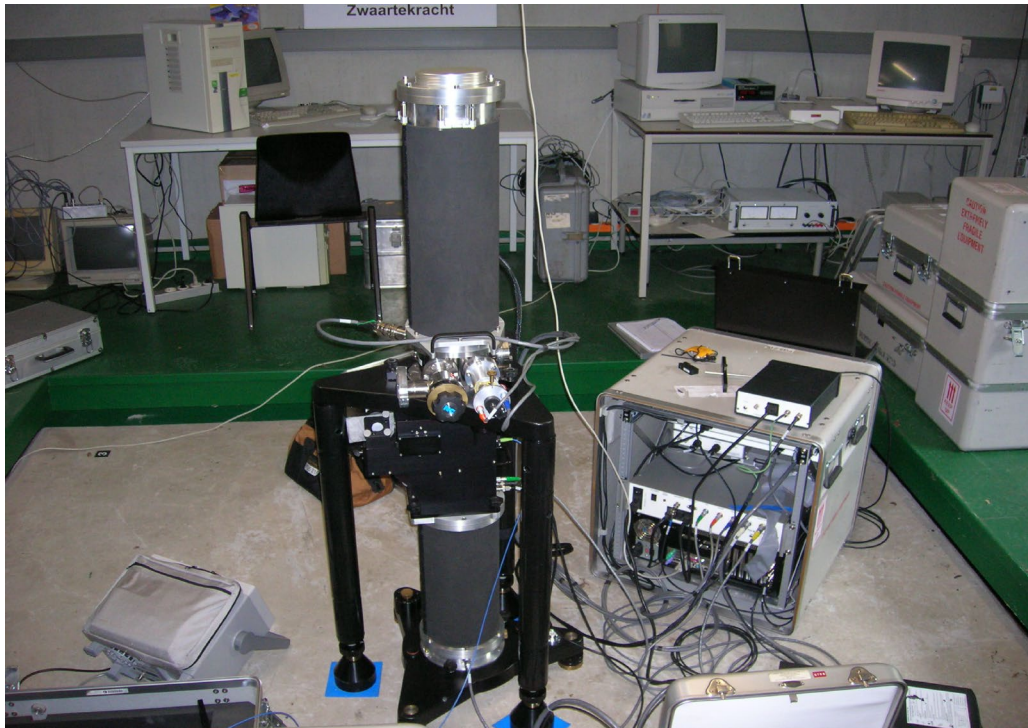




EUROPEAN CENTER FOR GEODYNAMICS AND SEISMOLOGY
CENTRE EUROPEEN DE GEODYNAMIQUE ET DE SEISMOLOGIE



ABSOLUTE GRAVITY MEASUREMENTS IN THE NETHERLANDS 2006

FINAL REPORT

September 25, 2006

Prof. Dr. Olivier Francis

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Foreword

This report contains the results of absolute gravity measurements carried in The Netherlands during June and July 2006. Acceleration due to gravity has been determined using an absolute gravimeter at the five following stations: Epen, Kootwijk, Wageningen, Westerbork and Zundert.

The absolute gravimeter FG5#216 (manufactured by MicrogLaCoste Inc.), from the European Center for Geodynamics and Seismology, was operated by Olivier Francis. Rene Reudink from TU Delft provided assistance and logistic support during the field campaign.

In this campaign, we reoccupied 4 stations. One new station has been established in Wageningen to complement the Dutch absolute gravity network. The drop-to-drop scatters of the observations in Westerbork, Kootwijk and Zundert can be considered as medium range values. The station in Epen is still by far the best one. On the other hand, the microseismic noise level is very high at the new station in Wageningen: the drop-to-drop scatter is about 80 microgal to be compared with the 5 microgal in the station of Epen. Overall, the mean set standard deviations for all the station are excellent with the highest value around 2 microgal and close to 1 microgal for most of the stations.

Data processing

Raw data from the absolute gravimeters consist of vectors of time and position of the falling object during the drops. To obtain the gravity value, a linear equation representing the equation of motion is fit to the raw data including the gravity gradient which as been measured with relative meters.

The data processing follows the protocol adopted during absolute gravimeters comparisons at the BIPM in Sèvres (Francis and van Dam, 2003). Geophysical corrections are applied to the raw gravity data: Earth tides using modelled tidal parameters, atmospheric pressure using a constant admittance, and the polar motion effect using pole positions from IERS.

The g-soft version 6.0 software from MicrogLaCoste Inc. was used for the processing. All the text outputs as well as some figures are compiled in the annexes of this report for future reference.

Vertical Gravity Gradient

The vertical gravity gradient was measured with a relative spring gravimeter Scintrex CG5 in Kootwijk and Wageningen. This gradient is needed to linearize the equation of motion but also to transfer the measured absolute gravity value from the reference height around 1.3 m to the floor. The final values of the linear vertical gravity gradient are given in Table 1.

Station	Vertical Gravity gradient /microgal/cm	Standard Deviation /microgal/cm
Kootwijk - Water Tower	-2.547	0.008
Wageningen	-2.832	0.011

Results of the absolute gravity measurements

In this table, we give the final values of the acceleration due to gravity for the 5 stations which have been occupied during this 2006 campaign. All the details like corrections or used parameters can be found in the annexes. For the station in Kootwijk, we use the vertical gravity gradient determined during this campaign. If one want to compare with the results in 2004, one must use the new gradient value to transfer the value from about 1.3 m to the floor.

Station	Date	Gravity value at the floor level /microgal	Mean Set Standard Deviation/microgal
Epen	6 July 2006	981 100 550.2	1.0
Kootwijk	19-20 June 2006	981 249 247.0	1.4
Wageningen	20-21 June 2006	981 229 943.8	2.4
Westerbork	21-22 June 2006	981 309 073.6	1.2
Zundert	15-16 June 2006	981 196 846.7	1.0

Reference

Francis O., van Dam T.M., Processing of the Absolute data of the ICAG01, Cahiers du Centre Européen de Géodynamique et de Séismologie, vol.22, 45-48, 2003.
<https://doi.org/10.5281/zenodo.7890604>

Epen



STATION: EPEN												
City:	EPEN					Country:	The Netherlands					
Location:	Seismological Observatory					Particularity:						
Situation:	Gravity Pier					Remarks:						
Date:	6 July 2006											
Code number:												
Latitude:	50.7631 degrees											
Longitude:	5.9311 degrees											
Elevation:	140 m											
Gradient:	-2.132 $\mu\text{gal}/\text{cm}$											
Reference height:	0.1287 m + 1.1640 m = 1.2927 m											
Meter:	FG5											
S/N:	216											
Ocean loading correction (μgal, Greenwich degree)												
Wave	M ₂	S ₂	K ₁	O ₁	N ₂	P ₁	K ₂	Q ₁	M _f	M _m	S _{sa}	
Ampl.	1.522	0.461	0.206	0.115	0.311	0.063	0.131	0.043	0.0	0.0	0.0	
Phase:	47.7	19.7	63.7	145.5	73.1	64.6	25.6	-169.7	0.0	0.0	0.0	
Polar motion correction						Air pressure correction						
X-coordinate:	0.1290			arc seconds			Nominal air pressure:			996.54 mbar		
Y-coordinate:	0.2942			arc seconds			Barometric admittance factor:			0.3 $\mu\text{gal}/\text{mbar}$		
Gravity												
Set gravity mean:	9 81 100 550.2					microgal						
Set std. dev.:	1.0					microgal						
Mean std. dev.:	4.7					microgal						
Number of sets:	20											
Number of drops per set:	100											
Drop interval:	10 seconds											
Set interval:	30 minutes											
Nominal/datum height:	0.0 cm											
Author: O. Francis	University of Luxembourg											
Date: September 25, 2006												

Project file

Micro-g Solutions g Processing Report

File Created: 07/17/06, 08:19:42

Project Name: ep20060706

g Acquisition Version: 1.082300

g Processing Version: 6.060320

Company/Institution: ECGS

Operator: Olivier Francis

Station Data

Name: Epen

Site Code: Seismological observatory

Lat: 52.76310 Long: 5.93110 Elev: 140.00 m

Reference Height: 12.87 cm

Datum Height: 0.00 cm

Gradient: -2.132 μ Gal/cm

Nominal Air Pressure: 996.54 mBar

Barometric Admittance Factor: 0.30

Polar Motion Coord: 0.1290 " 0.2942 "

Earth Tide (ETGTAB) Selected

Potential Filename: C:\Program Files\Micro-g Solutions Inc\gWavefiles\Etcpot.dat

Delta Factor Filename: F:\ABSOLU\DATA\2006\EPEN\OceanLoad-Epen.dff

Delta Factors

Start	Stop	Amplitude	Phase	Term
0.000000	0.002427	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: F:\ABSOLU\DATA\2006\EPEN\OceanLoad-Epen.olf

Waves: M2 S2 K1 O1 N2 P1 K2 Q1 Mf Mm Ssa

Amplitude (μ Gal): 1.522 0.461 0.206 0.115 0.311 0.063 0.131 0.043 0.000 0.000 0.000

Phase (deg): 47.7 19.7 63.7 145.5 73.1 64.6 25.6 -169.7 0.0 0.0 0.0

Instrument Data

Meter Type: FG5

Meter S/N: 216

Factory Height: 116.40 cm

Rubidium Frequency: 10000000.01020 Hz

Laser: WEO100 (187)

ID: 632.99117754 nm (0.02 V)

IE: 632.99119473 nm (-0.51 V)

IF: 632.99121259 nm (-0.92 V)

IG: 632.99123023 nm (-1.31 V)

IH: 632.99136890 nm (-1.85 V)

II: 632.99139822 nm (-1.57 V)

IJ: 632.99142704 nm (-1.30 V)

Modulation Frequency: 8333.420 Hz

Processing Results

Date: 07/06/06

Time: 18:37:40

DOY: 187

Year: 2006

Time Offset (D h:m:s): 0 0:0:0

Gravity: 981100550.18 μGal

Set Scatter: 0.96 μGal

Measurement Precision: 0.21 μGal

Total Uncertainty: 0.21 μGal

Number of Sets Collected: 20

Number of Sets Processed: 20

Set #s Processed: 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20

Number of Sets NOT Processed: 0

Set #s NOT Processed:

Number of Drops/Set: 100

Total Drops Accepted: 1805

Total Drops Rejected: 195

Total Fringes Acquired: 700

Fringe Start: 7

Processed Fringes: 613

GuideCard Multiplex: 4

GuideCard Scale Factor: 250

Acquisition Settings

Set Interval: 30 min

Drop Interval: 10 sec

Number of Sets: 48

Number of Drops: 100

Gravity Corrections

Earth Tide (ETGTAB): -64.60 μGal

Ocean Load: 0.16 μGal

Polar Motion: -1.81 μGal

Barometric Pressure: 1.51 μGal

Datum Height: 275.60 μGal

Reference X_o: -0.00 μGal

Uncertainties

Sigma Reject: 3.00

Earth Tide Factor: 0.000

Average Earth Tide Uncertainty: 0.00 μGal

Ocean Load Factor: 0.00

Average Ocean Load Uncertainty: 0.00 μGal

Barometric: 0.00 μGal

Polar Motion: 0.00 μGal

Laser: 0.00 μGal

Clock: 0.00 μGal

System Type: 0.00 μGal

Tidal Swell: 0.00 μGal

Water Table: 0.00 μGal

Unmodeled: 0.00 μGal

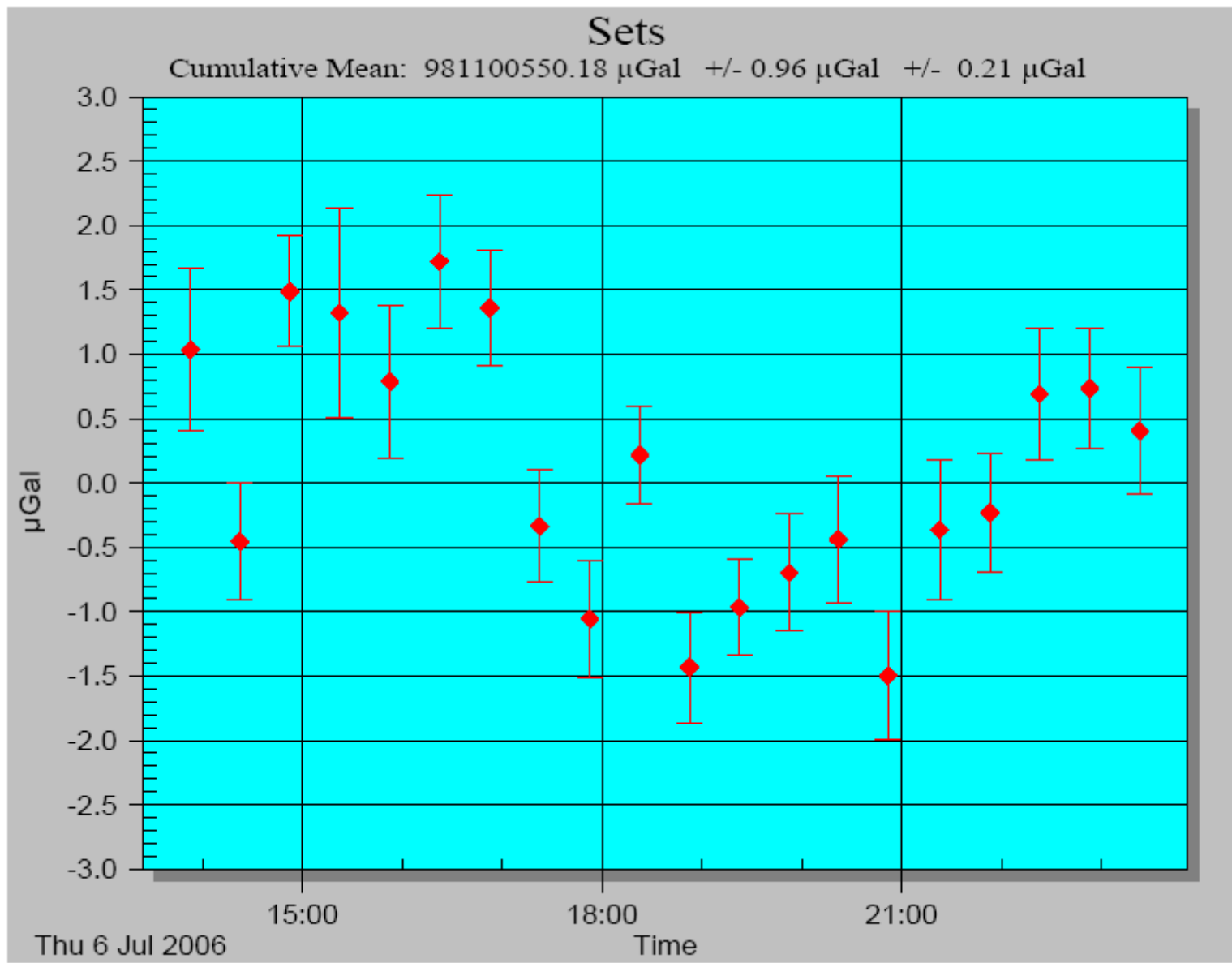
System Setup: 0.00 μGal

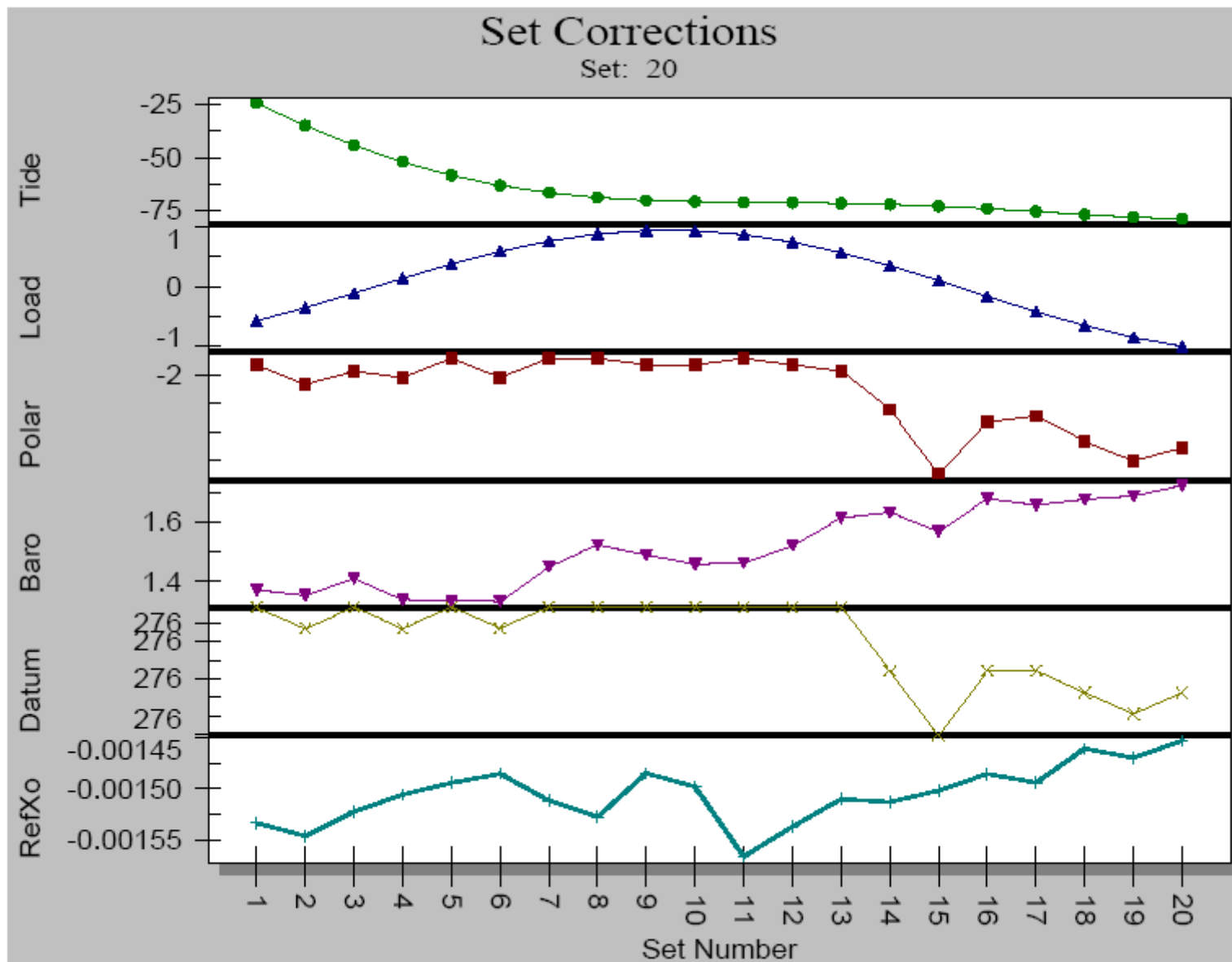
Gradient: 0.00 μGal (0.00 $\mu\text{Gal}/\text{cm}$)

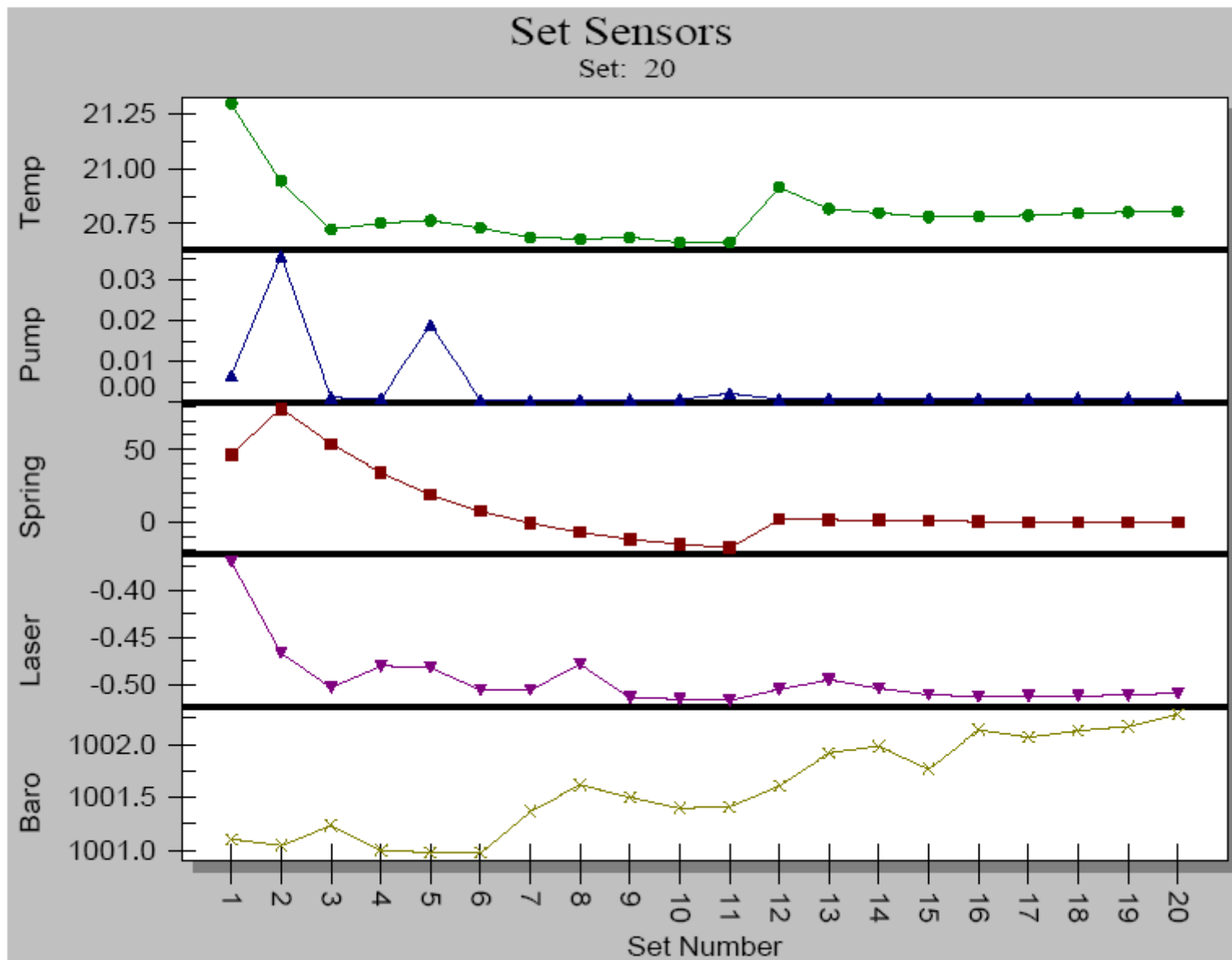
Set File

Source Data Filename: ep20060706
g Acquisition Version: 1.082300
g Processing Version: 6.060320

Set	Time	DOY	Year	Gravity	Sigma	ErrorUncert	Tide	Load	Baro	Polar	Datum	Refxo	Temp	Pres	Accept	Reject
1	13:52:46	187	2006	981100551.211	6.240	0.634	0.634	-24.581	-0.578	1.370	-1.806	275.604	-0.002	21.297	1001.106	97 3
2	14:22:28	187	2006	981100549.723	4.341	0.455	0.455	-34.979	-0.358	1.353	-1.806	275.604	-0.002	20.944	1001.049	91 9
3	14:52:31	187	2006	981100551.662	4.212	0.430	0.430	-44.212	-0.113	1.410	-1.806	275.604	-0.002	20.723	1001.239	96 4
4	15:22:27	187	2006	981100551.497	7.918	0.821	0.821	-51.953	0.137	1.338	-1.806	275.604	-0.002	20.753	1001.000	93 7
5	15:52:40	187	2006	981100550.964	5.917	0.592	0.592	-58.240	0.378	1.333	-1.806	275.604	-0.001	20.764	1000.983	100 0
6	16:22:30	187	2006	981100551.894	4.977	0.516	0.516	-62.975	0.590	1.332	-1.806	275.604	-0.001	20.731	1000.978	93 7
7	16:52:40	187	2006	981100551.535	4.428	0.443	0.443	-66.395	0.764	1.449	-1.806	275.604	-0.002	20.688	1001.371	100 0
8	17:22:40	187	2006	981100549.842	4.329	0.433	0.433	-68.628	0.885	1.523	-1.806	275.604	-0.002	20.679	1001.617	100 0
9	17:52:48	187	2006	981100549.120	4.463	0.451	0.451	-69.943	0.946	1.489	-1.806	275.604	-0.001	20.687	1001.503	98 2
10	18:22:38	187	2006	981100550.391	3.744	0.378	0.378	-70.599	0.943	1.457	-1.806	275.604	-0.001	20.664	1001.398	98 2
11	18:52:43	187	2006	981100548.743	4.272	0.429	0.429	-70.886	0.875	1.462	-1.806	275.604	-0.002	20.664	1001.412	99 1
12	19:22:42	187	2006	981100549.209	3.672	0.373	0.373	-71.054	0.747	1.521	-1.806	275.604	-0.002	20.917	1001.611	97 3
13	19:52:38	187	2006	981100549.478	4.443	0.453	0.453	-71.314	0.567	1.613	-1.806	275.604	-0.002	20.818	1001.918	96 4
14	20:22:10	187	2006	981100549.736	4.479	0.489	0.489	-71.807	0.348	1.632	-1.806	275.604	-0.002	20.798	1001.981	84 16
15	20:51:58	187	2006	981100548.678	4.213	0.500	0.500	-72.617	0.101	1.569	-1.806	275.604	-0.002	20.780	1001.769	71 29
16	21:23:00	187	2006	981100549.811	4.950	0.547	0.547	-73.786	-0.169	1.678	-1.806	275.604	-0.001	20.784	1002.134	82 18
17	21:53:09	187	2006	981100549.943	4.241	0.466	0.466	-75.146	-0.426	1.658	-1.806	275.604	-0.001	20.787	1002.066	83 17
18	22:22:45	187	2006	981100550.866	4.477	0.510	0.510	-76.531	-0.657	1.677	-1.806	275.604	-0.001	20.797	1002.128	77 23
19	22:53:05	187	2006	981100550.907	4.007	0.466	0.466	-77.765	-0.857	1.688	-1.806	275.604	-0.001	20.803	1002.167	74 26
20	23:23:12	187	2006	981100550.579	4.289	0.492	0.492	-78.521	-1.004	1.723	-1.806	275.604	-0.001	20.803	1002.284	76 24







Kootwijk

Water Tower



STATION: KOOTWIJK											
City:	Kootwijk					Country:	The Netherlands				
Location:	Water Tower					Particularity:					
Situation:	Gravity Pier					Remarks:					
Date:	19-20 June 2006										
Code number:											
Latitude:	52.1785 degrees										
Longitude:	5.8103 degrees										
Elevation:	44.11 m										
Gradient:	-2.547 μ gal/cm										
Reference height:	0.1210 m + 1.164 m = 1.285 m										
Meter:	FG5										
S/N:	216										
Ocean loading correction (μgal, Greenwich degree)											
Wave	M ₂	S ₂	K ₁	O ₁	N ₂	P ₁	K ₂	Q ₁	M _f	M _m	S _{sa}
Ampl.	1.650	0.513	0.222	0.129	0.333	0.069	0.145	0.047	0.0	0.0	0.0
Phase:	54.2	23.9	62.2	149.3	78.0	64.3	29.4	-164.4	0.0	0.0	0.0
Polar motion correction						Air pressure correction					
X-coordinate:	0.1263			arc seconds			Nominal air pressure:	1007.96 mbar			
Y-coordinate:	0.3120			arc seconds			Barometric admittance factor:	0.3 μ gal/mbar			
Gravity											
Set gravity mean:	9 81 249 247.0					microgal					
Set std. dev.:	1.4					microgal					
Mean std. dev.:	38.6					microgal					
Number of sets:	14										
Number of drops per set:	200										
Drop interval:	5 seconds										
Set interval:	60 minutes										
Nominal/datum height:	0.0 cm										
Author:	O. Francis					University of Luxembourg					
Date:	October 3, 2006										

Project file

Micro-g Solutions g Processing Report
File Created: 10/03/06, 13:18:11
Project Name: ko200606
g Acquisition Version: 1.082300
g Processing Version: 6.060320
Company/Institution: University of Luxembourg
Operator: Olivier Francis

Station Data

Name: Kootwijk
Site Code: Water Tower
Lat: 52.17850 Long: 5.81030 Elev: 44.11 m
Reference Height: 12.10 cm
Datum Height: 0.00 cm
Gradient: -2.547 μ Gal/cm
Nominal Air Pressure: 1007.96 mBar
Barometric Admittance Factor: 0.30
Polar Motion Coord: 0.1263 " 0.3120 "
Earth Tide (ETGTAB) Selected
Potential Filename: C:\Program Files\Micro-g Solutions Inc\gWavefiles\Etcpot.dat
Delta Factor Filename: F:\ABSOLU\DATA\INI\OceanLoad-Kootwijk.dff
Delta Factors

Start	Stop	Amplitude	Phase Term
0.000000	0.002427	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: F:\ABSOLU\DATA\INI\OceanLoad-Kootwijk.olf

Waves: M2 S2 K1 O1 N2 P1 K2 Q1 Mf Mm Ssa
Amplitude (μ Gal): 1.650 0.513 0.222 0.129 0.333 0.069 0.145 0.047 0.000 0.000 0.000
Phase (deg): 54.2 23.9 62.2 149.3 78.0 64.3 29.4 -164.4 0.0 0.0 0.0

Instrument Data

Meter Type: FG5
Meter S/N: 216
Factory Height: 116.40 cm
Rubidium Frequency: 10000000.01020 Hz
Laser: WEO100 (187)
ID: 632.99117754 nm (0.01 V)
IE: 632.99119473 nm (-0.51 V)
IF: 632.99121259 nm (-0.92 V)
IG: 632.99123023 nm (-1.31 V)
IH: 632.99136890 nm (-1.85 V)
II: 632.99139822 nm (-1.57 V)
IJ: 632.99142704 nm (-1.30 V)

Modulation Frequency: 8333.420 Hz

Processing Results

Date: 06/19/06

Time: 22:10:36

DOY: 170

Year: 2006

Time Offset (D h:m:s): 0 0:0:0

Gravity: 981249247.03 μ Gal

Set Scatter: 1.41 μ Gal

Measurement Precision: 0.38 μ Gal

Total Uncertainty: 0.38 μ Gal

Number of Sets Collected: 14

Number of Sets Processed: 14

Set #s Processed: 1,2,3,4,5,6,7,8,9,10,11,12,13,14

Number of Sets NOT Processed: 0

Set #s NOT Processed:

Number of Drops/Set: 200

Total Drops Accepted: 2597

Total Drops Rejected: 203

Total Fringes Acquired: 700

Fringe Start: 7

Processed Fringes: 613

GuideCard Multiplex: 4

GuideCard Scale Factor: 250

Acquisition Settings

Set Interval: 60 min

Drop Interval: 5 sec

Number of Sets: 14

Number of Drops: 200

Gravity Corrections

Earth Tide (ETGTAB): -50.52 μ Gal

Ocean Load: 0.12 μ Gal

Polar Motion: -1.74 μ Gal

Barometric Pressure: 0.04 μ Gal

Datum Height: 327.29 μ Gal

Reference X_o: -0.00 μ Gal

Uncertainties

Sigma Reject: 3.00

Earth Tide Factor: 0.000

Average Earth Tide Uncertainty: 0.00 μ Gal

Ocean Load Factor: 0.00

Average Ocean Load Uncertainty: 0.00 μ Gal

Barometric: 0.00 μ Gal

Polar Motion: 0.00 μ Gal

Laser: 0.00 μ Gal

Clock: 0.00 μ Gal

System Type: 0.00 μ Gal

Tidal Swell: 0.00 μ Gal

Water Table: 0.00 μ Gal

Unmodeled: 0.00 μ Gal

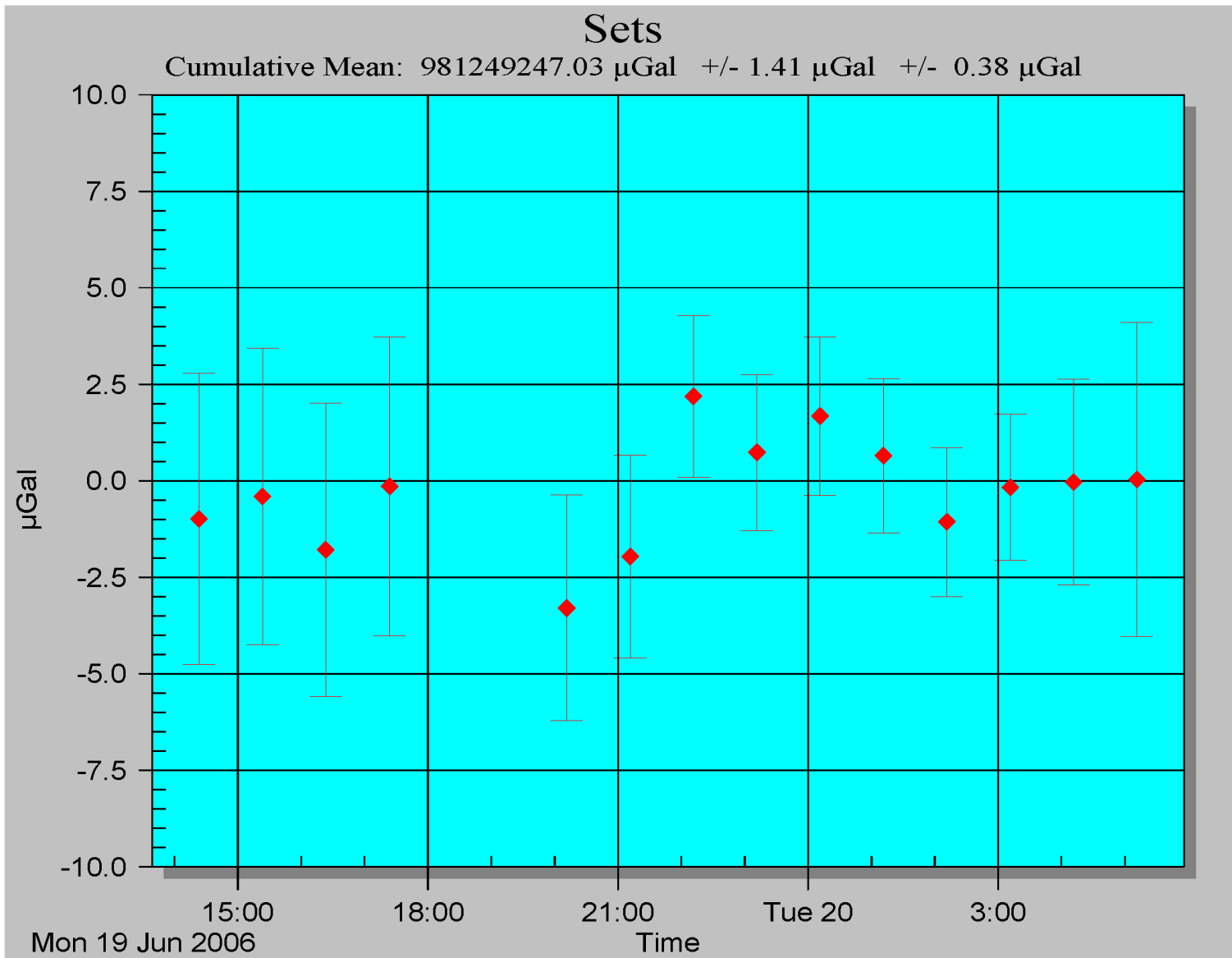
System Setup: 0.00 μ Gal

Gradient: 0.00 μ Gal (0.00 μ Gal/cm)

Set File

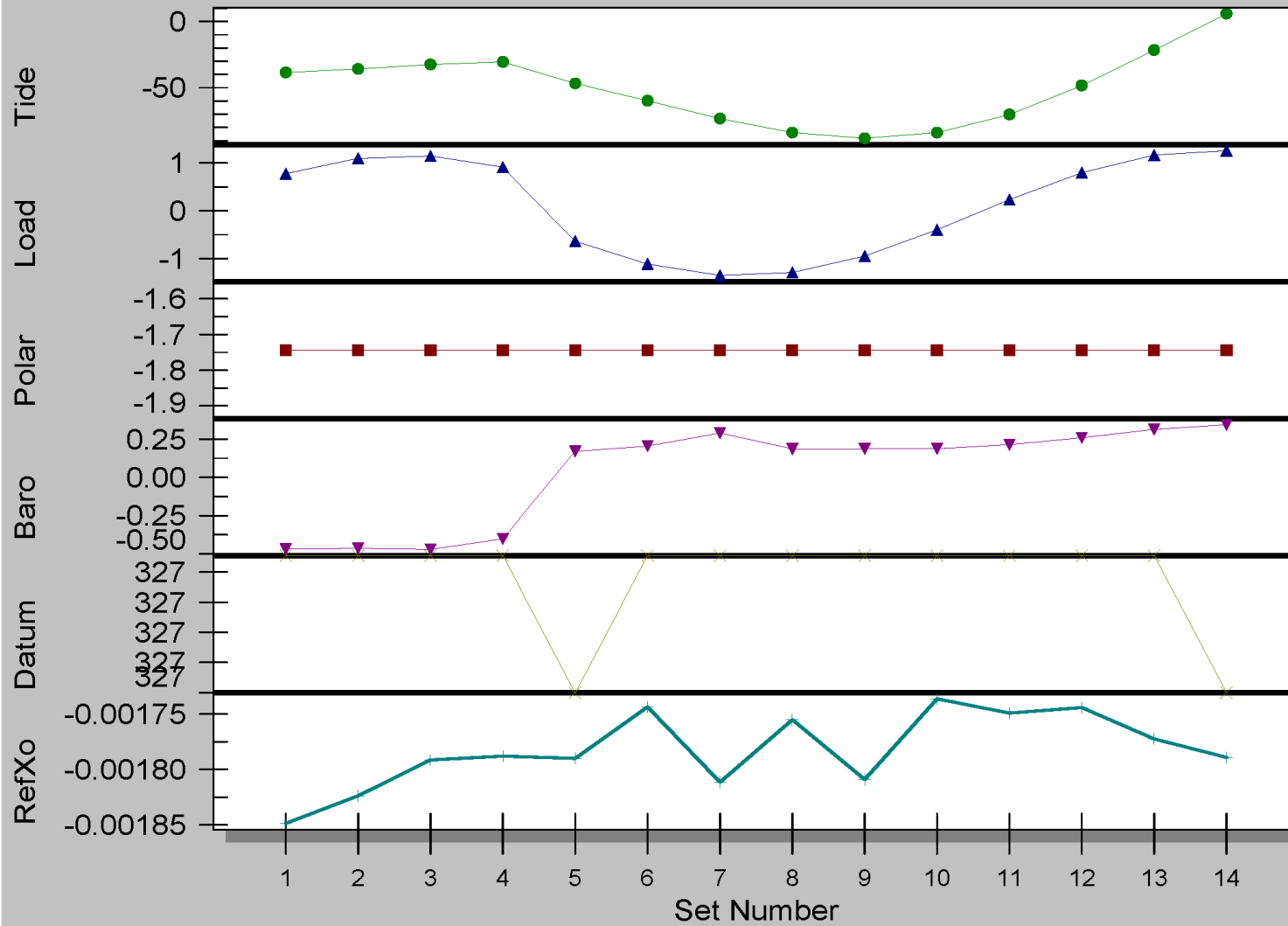
Source Data Filename: ko200606
g Acquisition Version: 1.082300
g Processing Version: 6.060320

Set	Time	DOY	Year	Gravity	Sigma	ErrorUncert	Tide	Load	Baro	Polar	Datum	Refxo	Temp	Pres	Accept	Reject
1	14:23:16	170	2006	981249246.034	51.220	3.776	3.776	-38.418	0.773	-0.469	-1.744	327.289	-0.002	22.171	1006.398	184 16
2	15:23:22	170	2006	981249246.621	52.565	3.844	3.844	-35.927	1.090	-0.464	-1.744	327.289	-0.002	21.876	1006.414	187 13
3	16:23:17	170	2006	981249245.236	52.632	3.798	3.798	-32.454	1.143	-0.470	-1.744	327.289	-0.002	21.884	1006.392	192 8
4	17:23:39	170	2006	981249246.881	51.514	3.872	3.872	-30.479	0.909	-0.401	-1.744	327.289	-0.002	21.923	1006.624	177 23
5	20:11:27	170	2006	981249243.731	41.065	2.926	2.926	-46.747	-0.635	0.170	-1.744	327.289	-0.002	22.177	1008.527	197 3
6	21:11:41	170	2006	981249245.067	34.548	2.627	2.627	-59.869	-1.113	0.204	-1.744	327.289	-0.002	22.028	1008.641	173 27
7	22:11:26	170	2006	981249249.214	28.798	2.100	2.100	-73.315	-1.349	0.291	-1.744	327.289	-0.002	21.984	1008.929	188 12
8	23:11:32	170	2006	981249247.764	27.337	2.026	2.026	-83.882	-1.289	0.186	-1.744	327.289	-0.002	21.989	1008.580	182 18
9	00:11:24	171	2006	981249248.698	27.766	2.053	2.053	-88.178	-0.946	0.187	-1.744	327.289	-0.002	21.981	1008.583	183 17
10	01:11:25	171	2006	981249247.674	27.622	2.004	2.004	-83.870	-0.396	0.187	-1.744	327.289	-0.002	21.992	1008.584	190 10
11	02:11:30	171	2006	981249245.963	26.192	1.931	1.931	-70.165	0.234	0.214	-1.744	327.289	-0.002	22.003	1008.674	184 16
12	03:11:33	171	2006	981249246.856	25.669	1.897	1.897	-48.333	0.796	0.260	-1.744	327.289	-0.002	22.009	1008.827	183 17
13	04:11:30	171	2006	981249246.995	35.557	2.665	2.665	-21.531	1.163	0.314	-1.744	327.289	-0.002	22.011	1009.008	178 22
14	05:11:27	171	2006	981249247.061	57.450	4.072	4.072	5.868	1.253	0.344	-1.744	327.289	-0.002	22.024	1009.108	199 1



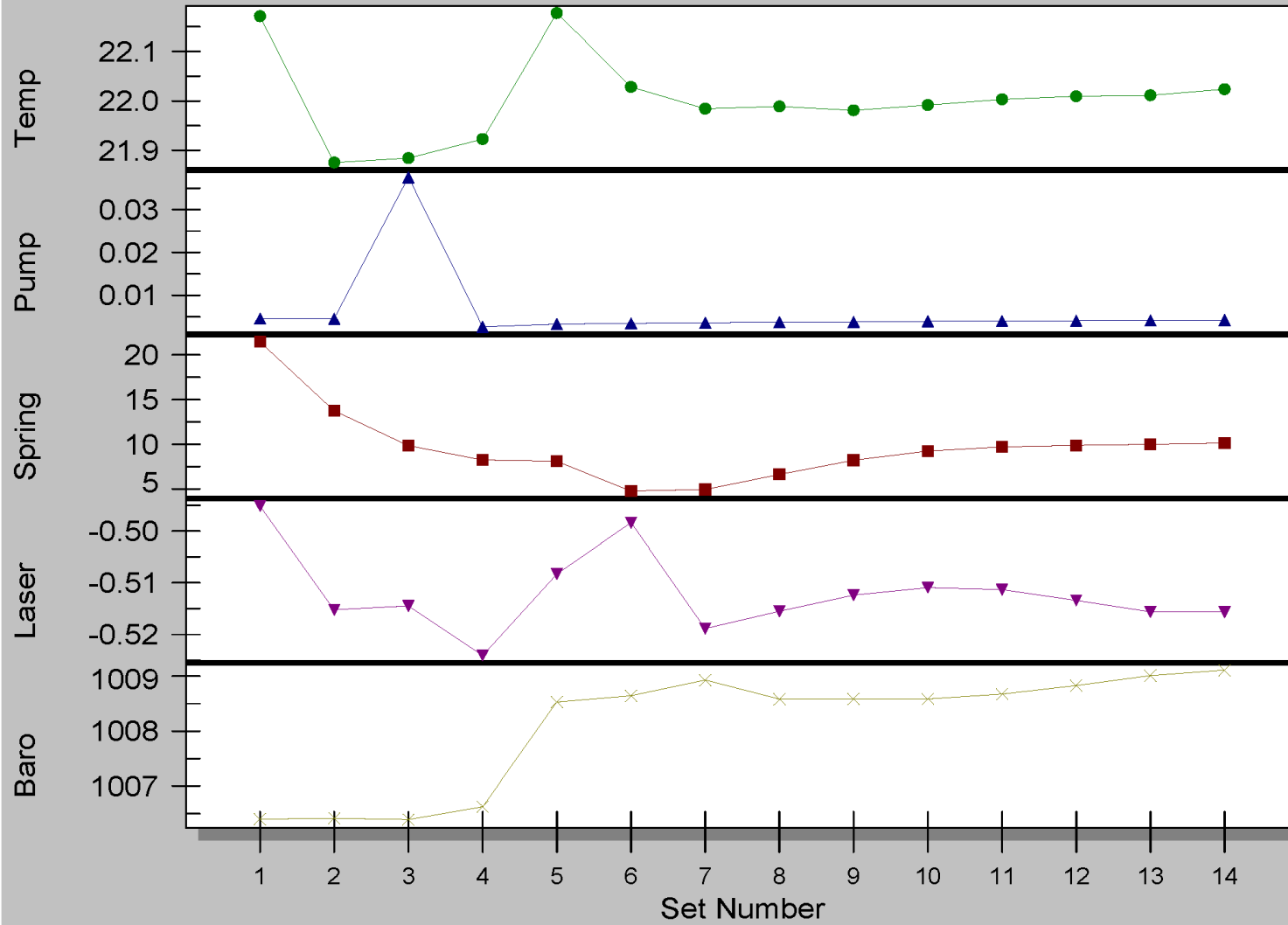
Set Corrections

Set: 14



Set Sensors

Set: 14



Wageningen



STATION: WAGENINGEN											
City:	Wageningen					Country:	The Netherlands				
Location:	National Herbarium Nederland					Particularity:					
Situation:						Remarks:					
Date:	20-21 June 2006										
Code number:											
Latitude:	51.96754 degrees										
Longitude:	5.67618 degrees										
Elevation:	27 m										
Gradient:	-2.832 μ gal/cm										
Reference height:	0.1305 m + 1.164 m = 1.2945 m										
Meter:	FG5										
S/N:	216										
Ocean loading correction (μgal, Greenwich degree)											
Wave	M ₂	S ₂	K ₁	O ₁	N ₂	P ₁	K ₂	Q ₁	M _f	M _m	S _{sa}
Ampl.	1.690	0.530	0.227	0.132	0.341	0.071	0.150	0.048	0.0	0.0	0.0
Phase:	56.1	25.4	62.3	150.5	79.4	64.6	30.8	-163.1	0.0	0.0	0.0
Polar motion correction						Air pressure correction					
X-coordinate:	0.1260		arc seconds			Nominal air pressure:			1010.01 mbar		
Y-coordinate:	0.3109		arc seconds			Barometric admittance factor:			0.3 μ gal/mbar		
Gravity											
Set gravity mean:	9 81 229 943.8					microgal					
Set std. dev.:	2.4					microgal					
Mean std. dev.:	82.5					microgal					
Number of sets:	8										
Number of drops per set:	200										
Drop interval:	5 seconds										
Set interval:	60/30 minutes										
Nominal/datum height:	0.0 cm										
Author:	O. Francis					University of Luxembourg					
Date:	October 3, 2006										

Project file

Micro-g Solutions g Processing Report
File Created: 10/03/06, 10:56:24
Project Name: wa200606
g Acquisition Version: 1.082300
g Processing Version: 6.060320
Company/Institution: University of Luxembourg
Operator: Olivier FRANCIS

Station Data

Name: Wageningen
Site Code: National Herbarium Nedreland
Lat: 51.96754 Long: 5.67618 Elev: 27.00 m
Reference Height: 13.05 cm
Datum Height: 0.00 cm
Gradient: -2.832 $\mu\text{Gal}/\text{cm}$
Nominal Air Pressure: 1010.01 mBar
Barometric Admittance Factor: 0.30
Polar Motion Coord: 0.1260 " 0.3109 "
Earth Tide (ETGTAB) Selected
Potential Filename: C:\Program Files\Micro-g Solutions Inc\gWavefiles\Etcpot.dat
Delta Factor Filename: F:\ABSOLU\DATA\INI\OceanLoad-Wageningen.dff
Delta Factors

Start	Stop	Amplitude	Phase Term
0.000000	0.002427	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: F:\ABSOLU\DATA\INI\OceanLoad-Wageningen.olf

Waves: M2 S2 K1 O1 N2 P1 K2 Q1 Mf Mm Ssa
Amplitude (μGal): 1.690 0.530 0.227 0.132 0.341 0.071 0.150 0.048 0.000 0.000 0.000
Phase (deg): 56.1 25.4 62.3 150.5 79.4 64.6 30.8 -163.1 0.0 0.0 0.0

Instrument Data

Meter Type: FG5
Meter S/N: 216
Factory Height: 116.40 cm
Rubidium Frequency: 10000000.01020 Hz
Laser: WEO100 (187)
ID: 632.99117754 nm (0.20 V)
IE: 632.99119473 nm (-0.28 V)
IF: 632.99121259 nm (-0.68 V)
IG: 632.99123023 nm (-1.31 V)
IH: 632.99136890 nm (-1.85 V)
II: 632.99139822 nm (-1.57 V)
IJ: 632.99142704 nm (-1.30 V)
Modulation Frequency: 8333.420 Hz
Processing Results

Date: 06/20/06
Time: 23:14:15
DOY: 171
Year: 2006
Time Offset (D h:m:s): 0 0:0:0
Gravity: 981229943.75 μ Gal
Set Scatter: 2.40 μ Gal
Measurement Precision: 0.85 μ Gal
Total Uncertainty: 0.85 μ Gal
Number of Sets Collected: 8
Number of Sets Processed: 8
Set #s Processed: 1,2,3,4,5,6,7,8
Number of Sets NOT Processed: 0
Set #s NOT Processed:
Number of Drops/Set: 200
Total Drops Accepted: 1575
Total Drops Rejected: 25
Total Fringes Acquired: 700
Fringe Start: 7
Processed Fringes: 613
GuideCard Multiplex: 4
GuideCard Scale Factor: 250

Acquisition Settings

Set Interval: 60 min
Drop Interval: 5 sec
Number of Sets: 8
Number of Drops: 200

Gravity Corrections

Earth Tide (ETGTAB): 23.06 μ Gal
Ocean Load: -0.11 μ Gal
Polar Motion: -1.76 μ Gal
Barometric Pressure: 0.07 μ Gal
Datum Height: 366.60 μ Gal
Reference Xo: -0.00 μ Gal

Uncertainties

Sigma Reject: 3.00
Earth Tide Factor: 0.000
Average Earth Tide Uncertainty: 0.00 μ Gal
Ocean Load Factor: 0.00
Average Ocean Load Uncertainty: 0.00 μ Gal
Barometric: 0.00 μ Gal
Polar Motion: 0.00 μ Gal
Laser: 0.00 μ Gal
Clock: 0.00 μ Gal
System Type: 0.00 μ Gal
Tidal Swell: 0.00 μ Gal
Water Table: 0.00 μ Gal
Unmodeled: 0.00 μ Gal
System Setup: 0.00 μ Gal
Gradient: 0.00 μ Gal (0.00 μ Gal/cm)

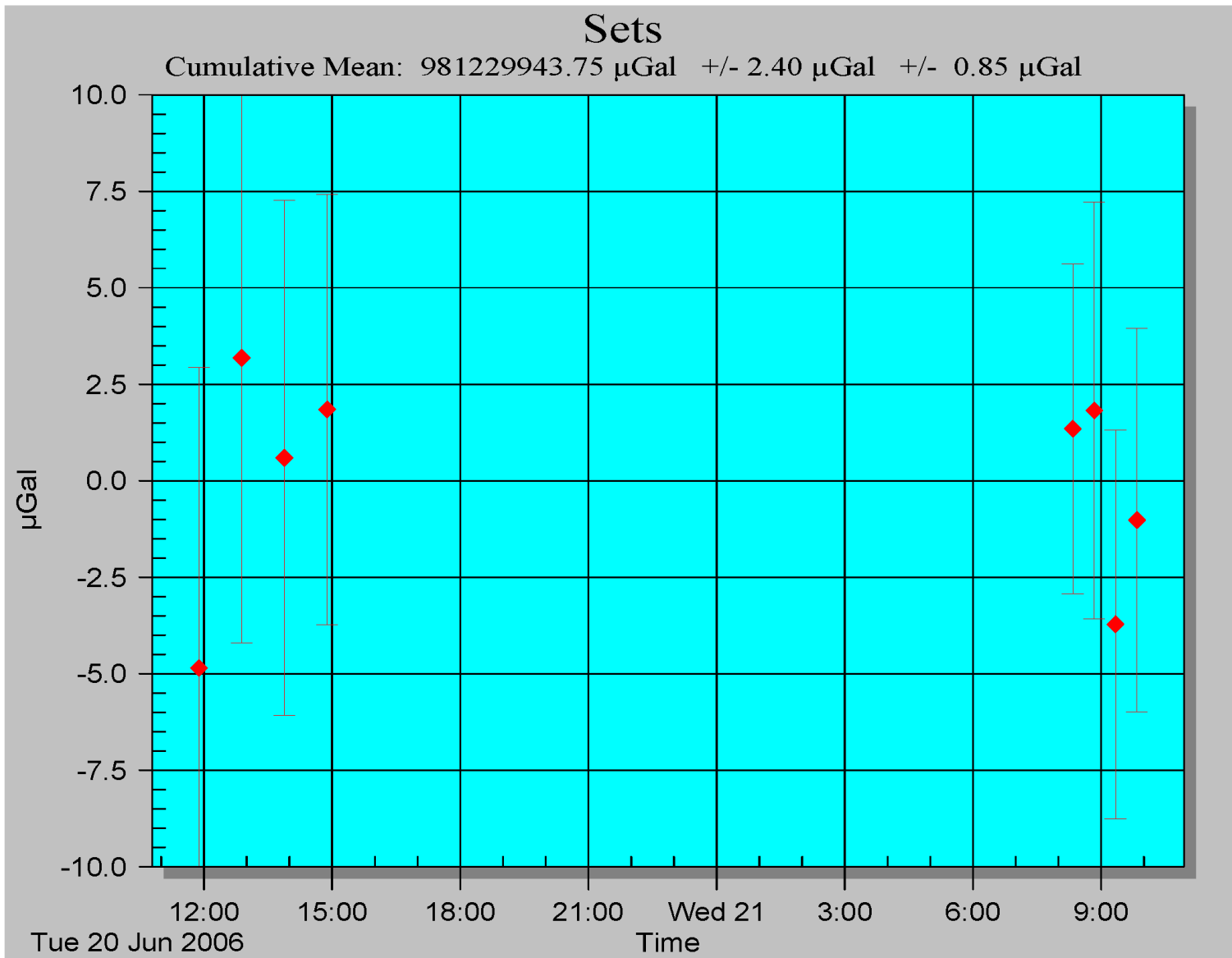
Comments:

Files Merged:
WG20060620.fg5
WG20060621.fg5

Set File

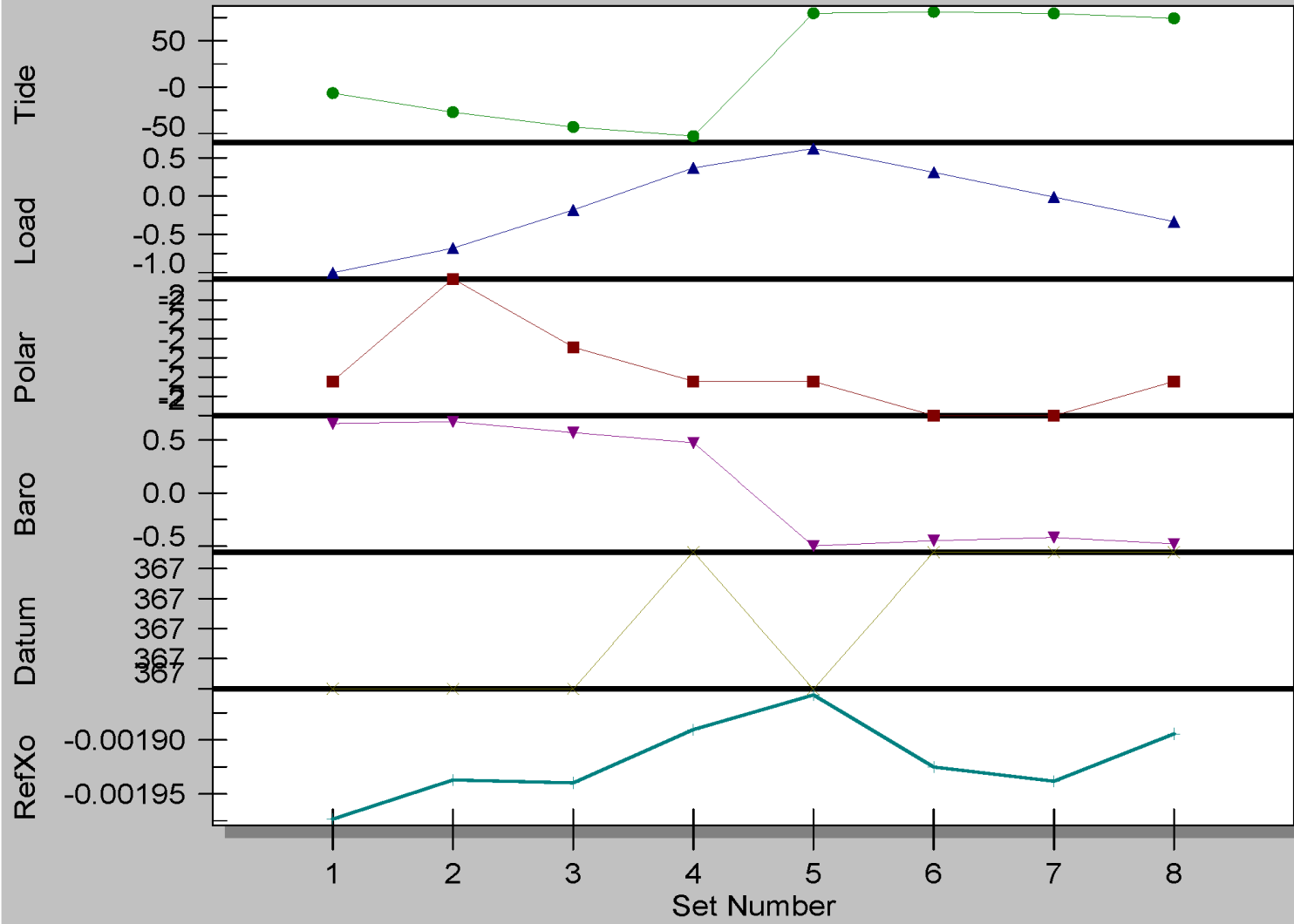
Source Data Filename: wa200606
g Acquisition Version: 1.082300
g Processing Version: 6.060320

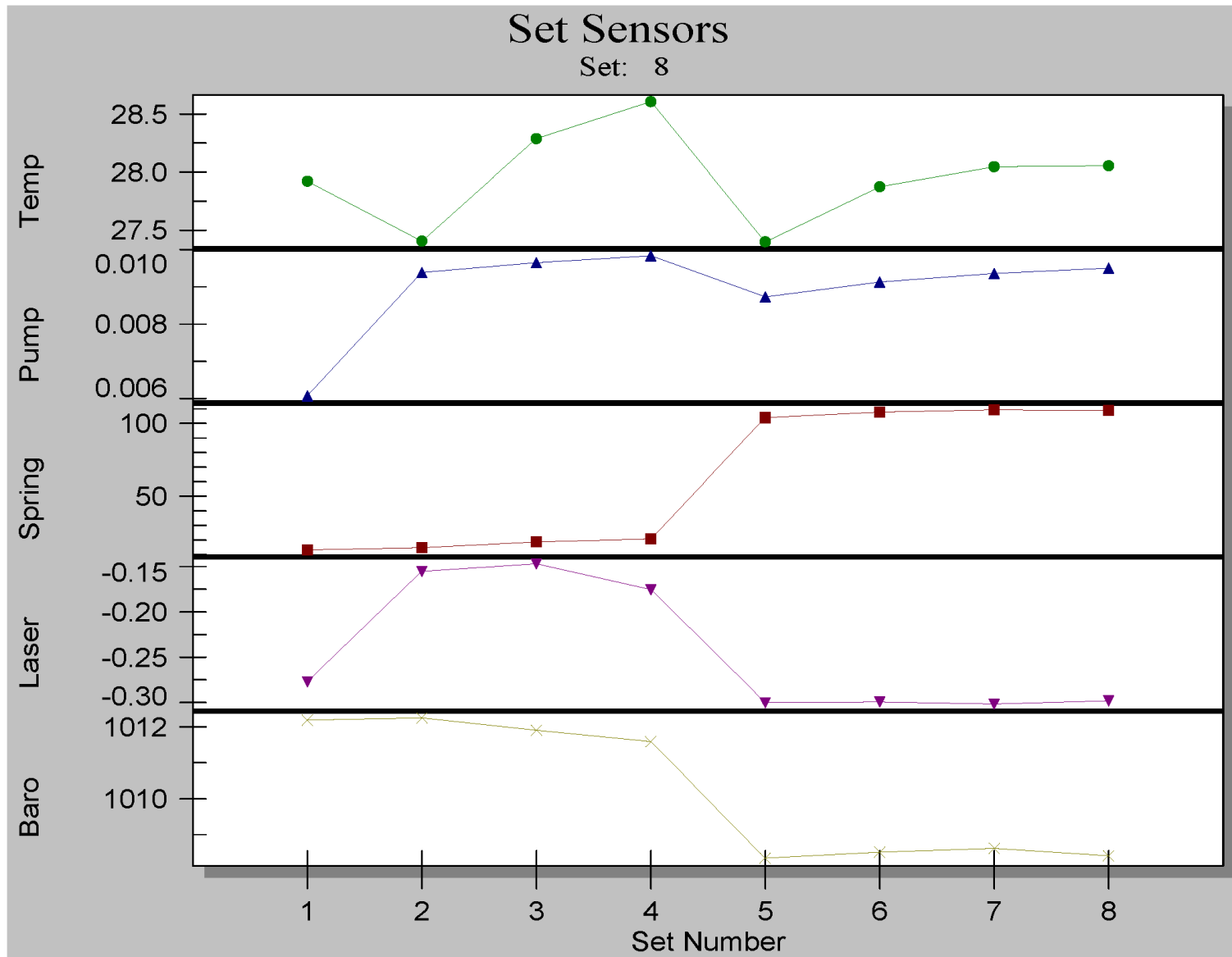
Set	Time	DOY	Year	Gravity	Sigma	ErrorUncert	Tide	Load	Baro	Polar	Datum	Refxo	Temp	Pres	Accept	Reject
1	11:53:17	171	2006	981229938.895	109.200	7.780	7.780	-6.621	-1.001	0.653	-1.758	366.602	-0.002	27.922	1012.188	197 3
2	12:53:19	171	2006	981229946.934	102.056	7.385	7.385	-27.002	-0.682	0.671	-1.758	366.602	-0.002	27.407	1012.246	191 9
3	13:53:19	171	2006	981229944.339	93.402	6.672	6.672	-42.910	-0.182	0.568	-1.758	366.602	-0.002	28.288	1011.904	196 4
4	14:53:14	171	2006	981229945.592	78.458	5.576	5.576	-52.779	0.368	0.473	-1.758	366.602	-0.002	28.606	1011.588	198 2
5	08:20:15	172	2006	981229945.094	59.911	4.268	4.268	79.481	0.622	-0.498	-1.758	366.602	-0.002	27.400	1008.351	197 3
6	08:50:13	172	2006	981229945.566	76.127	5.396	5.396	81.019	0.311	-0.448	-1.758	366.602	-0.002	27.874	1008.516	199 1
7	09:20:12	172	2006	981229940.027	71.077	5.039	5.039	79.192	-0.015	-0.417	-1.758	366.602	-0.002	28.046	1008.619	199 1
8	09:50:12	172	2006	981229942.729	69.931	4.970	4.970	74.134	-0.335	-0.479	-1.758	366.602	-0.002	28.055	1008.415	198 2



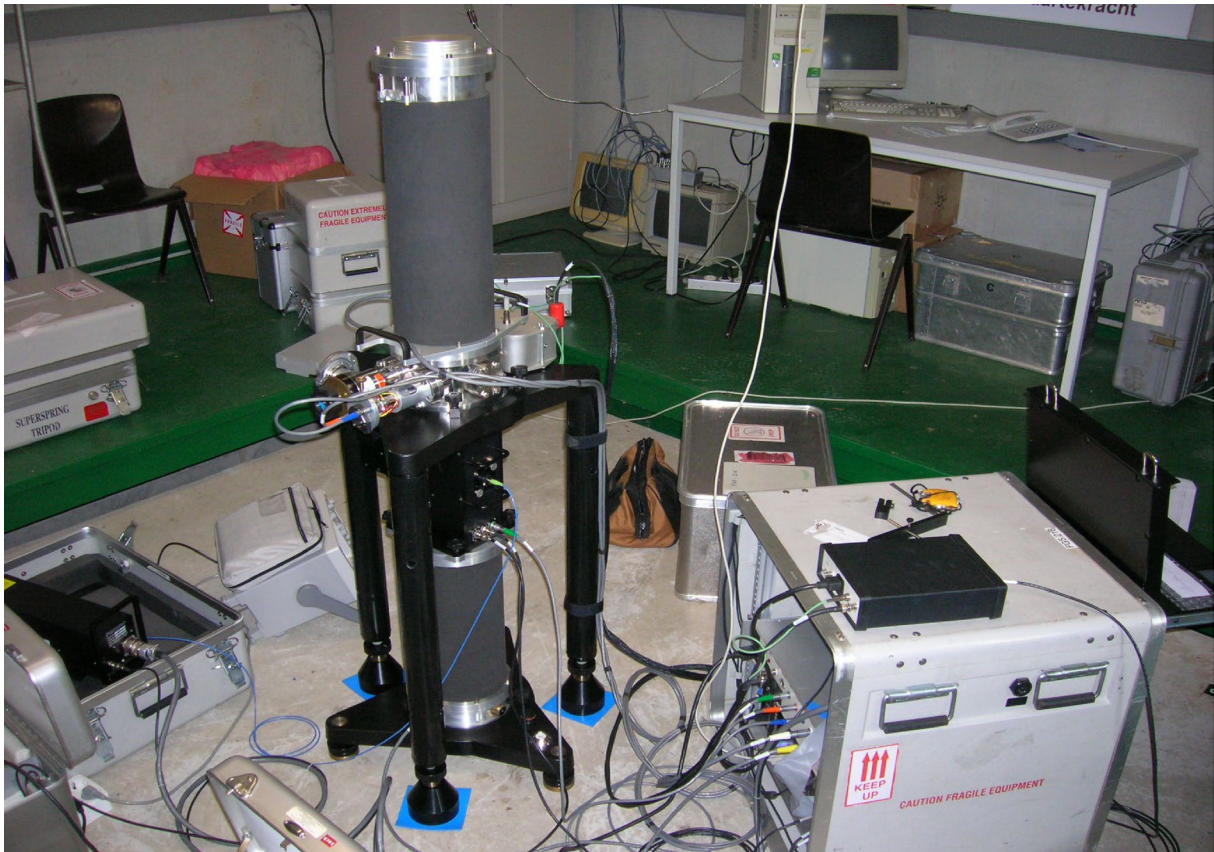
Set Corrections

Set: 8





Westerbork



STATION: WESTERBORK												
City:	Westerbork					Country:	The Netherlands					
Location:	Radio Observatory					Particularity:						
Situation:	Gravity Pier					Remarks:						
Date:	21-22 June 2006											
Code number:												
Latitude:	52.9148 degrees											
Longitude:	6.6038 degrees											
Elevation:	15.8 m											
Gradient:	-2.950 $\mu\text{gal}/\text{cm}$											
Reference height:	0.1245 m + 1.164 m = 1.2885 m											
Meter:	FG5											
S/N:	216											
Ocean loading correction (μgal, Greenwich degree)												
Wave	M ₂	S ₂	K ₁	O ₁	N ₂	P ₁	K ₂	Q ₁	M _f	M _m	S _{sa}	
Ampl.	1.335	0.435	0.221	0.128	0.287	0.065	0.125	0.0045	0.0	0.0	0.0	
Phase:	50.5	23.9	61.2	150.5	75.3	63.8	30.0	-163.7	0.0	0.0	0.0	
Polar motion correction						Air pressure correction						
X-coordinate:	0.1255			arc seconds			Nominal air pressure:			1011.35 mbar		
Y-coordinate:	0.3101			arc seconds			Barometric admittance factor:			0.3 $\mu\text{gal}/\text{mbar}$		
Gravity												
Set gravity mean:	9 81 309 073.6					microgal						
Set std. dev.:	1.2					microgal						
Mean std. dev.:	32.2					microgal						
Number of sets:	17											
Number of drops per set:	100											
Drop interval:	5 seconds											
Set interval:	60 minutes											
Nominal/datum height:	0.0 cm											
Author:	O. Francis					University of Luxembourg						
Date:	September 26, 2006											

Project file

Micro-g Solutions g Processing Report

File Created: 07/17/06, 09:45:05

Project Name: WE20060621

g Acquisition Version: 1.082300

g Processing Version: 6.060320

Company/Institution: ECGS

Operator: Olivier Francis

Station Data

Name: Westerbork

Site Code: Gravity bunker

Lat: 52.91480 Long: 6.60380 Elev: 15.80 m

Reference Height: 12.45 cm

Datum Height: 0.00 cm

Gradient: -2.950 μ Gal/cm

Nominal Air Pressure: 1011.35 mBar

Barometric Admittance Factor: 0.30

Polar Motion Coord: 0.1255 " 0.3101 "

Earth Tide (ETGTAB) Selected

Potential Filename: C:\Program Files\Micro-g Solutions Inc\gWavefiles\Etcpot.dat

Delta Factor Filename: F:\ABSOLU\DATA\2006\Westerbork\OceanLoad-Westerbork.dff

Delta Factors

Start	Stop	Amplitude	Phase	Term
0.000000	0.002427	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: F:\ABSOLU\DATA\2006\Westerbork\OceanLoad-Westerbork.olf

Waves: M2 S2 K1 O1 N2 P1 K2 Q1 Mf Mm Ssa

Amplitude (μ Gal): 1.335 0.435 0.211 0.128 0.287 0.065 0.125 0.045 0.000 0.000 0.000

Phase (deg): 50.5 23.9 61.2 150.5 75.3 63.8 30.0 -163.7 0.0 0.0 0.0

Instrument Data

Meter Type: FG5

Meter S/N: 216

Factory Height: 116.40 cm

Rubidium Frequency: 10000000.01020 Hz

Laser: WEO100 (187)

ID: 632.99117754 nm (0.20 V)

IE: 632.99119473 nm (-0.28 V)

IF: 632.99121259 nm (-0.68 V)

IG: 632.99123023 nm (-1.31 V)

IH: 632.99136890 nm (-1.85 V)

II: 632.99139822 nm (-1.57 V)

IJ: 632.99142704 nm (-1.30 V)

Modulation Frequency: 8333.420 Hz

Processing Results

Date: 06/21/06

Time: 22:35:25

DOY: 172

Year: 2006

Time Offset (D h:m:s): 0 0:0:0

Gravity: 981309073.60 μ Gal

Set Scatter: 1.19 μ Gal

Measurement Precision: 0.29 μ Gal

Total Uncertainty: 0.29 μ Gal

Number of Sets Collected: 17

Number of Sets Processed: 17

Set #s Processed: 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17

Number of Sets NOT Processed: 0

Set #s NOT Processed:

Number of Drops/Set: 100

Total Drops Accepted: 1671

Total Drops Rejected: 29

Total Fringes Acquired: 700

Fringe Start: 7

Processed Fringes: 613

GuideCard Multiplex: 4

GuideCard Scale Factor: 250

Acquisition Settings

Set Interval: 60 min

Drop Interval: 5 sec

Number of Sets: 24

Number of Drops: 100

Gravity Corrections

Earth Tide (ETGTAB): -56.25 μ Gal

Ocean Load: 0.07 μ Gal

Polar Motion: -1.64 μ Gal

Barometric Pressure: -1.49 μ Gal

Datum Height: 380.11 μ Gal

Reference Xo: -0.00 μ Gal

Uncertainties

Sigma Reject: 3.00

Earth Tide Factor: 0.000

Average Earth Tide Uncertainty: 0.00 μ Gal

Ocean Load Factor: 0.00

Average Ocean Load Uncertainty: 0.00 μ Gal

Barometric: 0.00 μ Gal

Polar Motion: 0.00 μ Gal

Laser: 0.00 μ Gal

Clock: 0.00 μ Gal

System Type: 0.00 μ Gal

Tidal Swell: 0.00 μ Gal

Water Table: 0.00 μ Gal

Unmodeled: 0.00 μ Gal

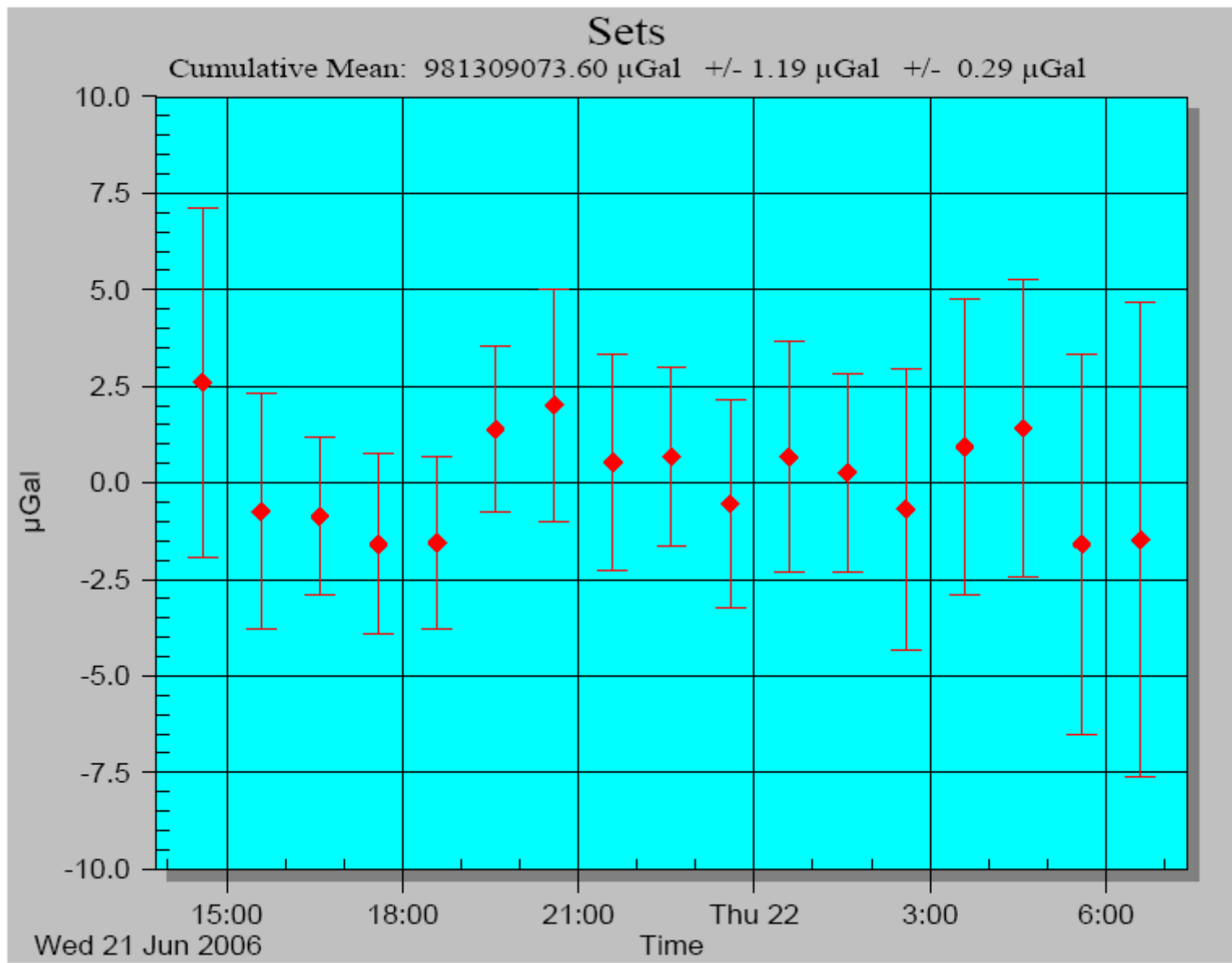
System Setup: 0.00 μ Gal

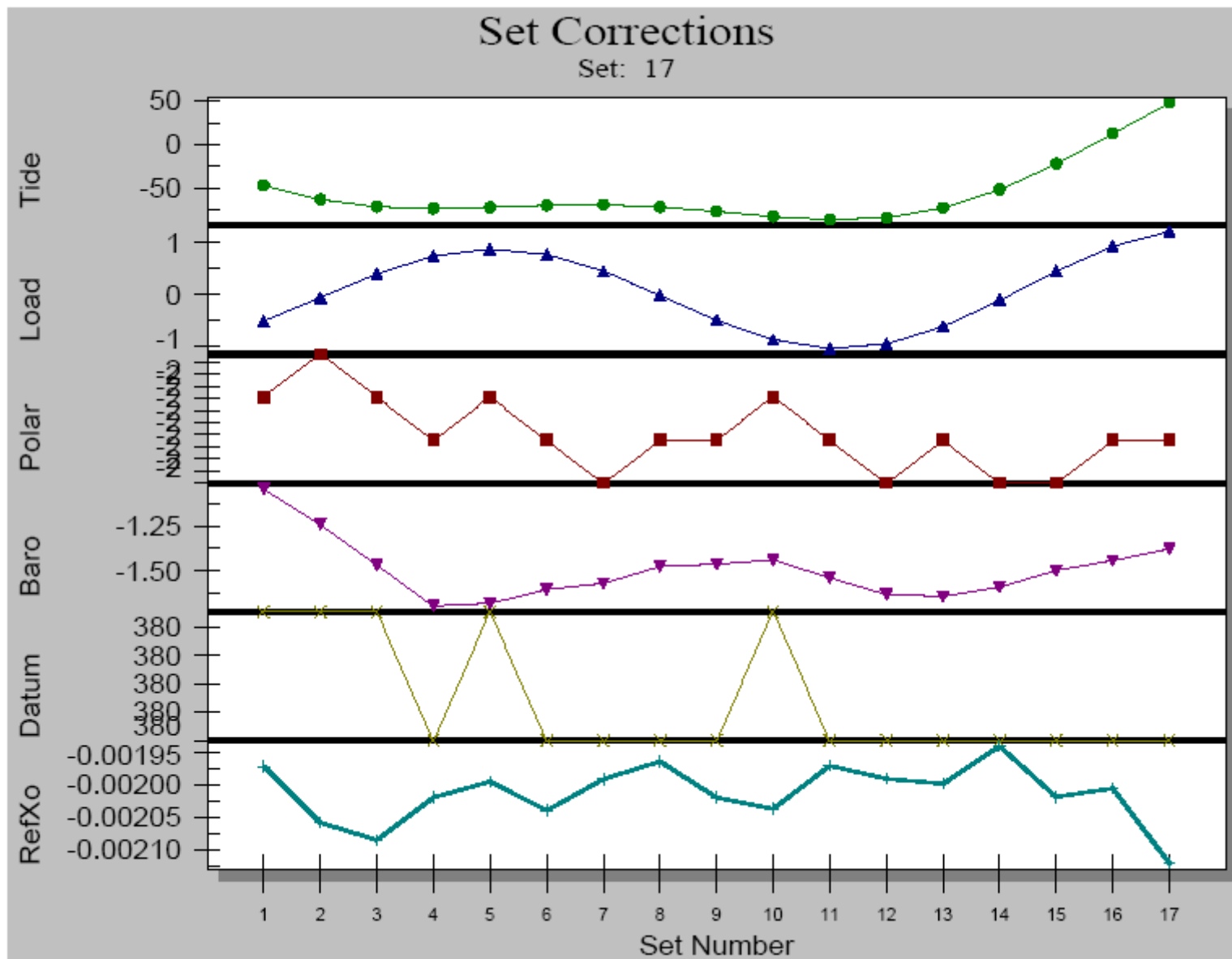
Gradient: 0.00 μ Gal (0.00 μ Gal/cm)

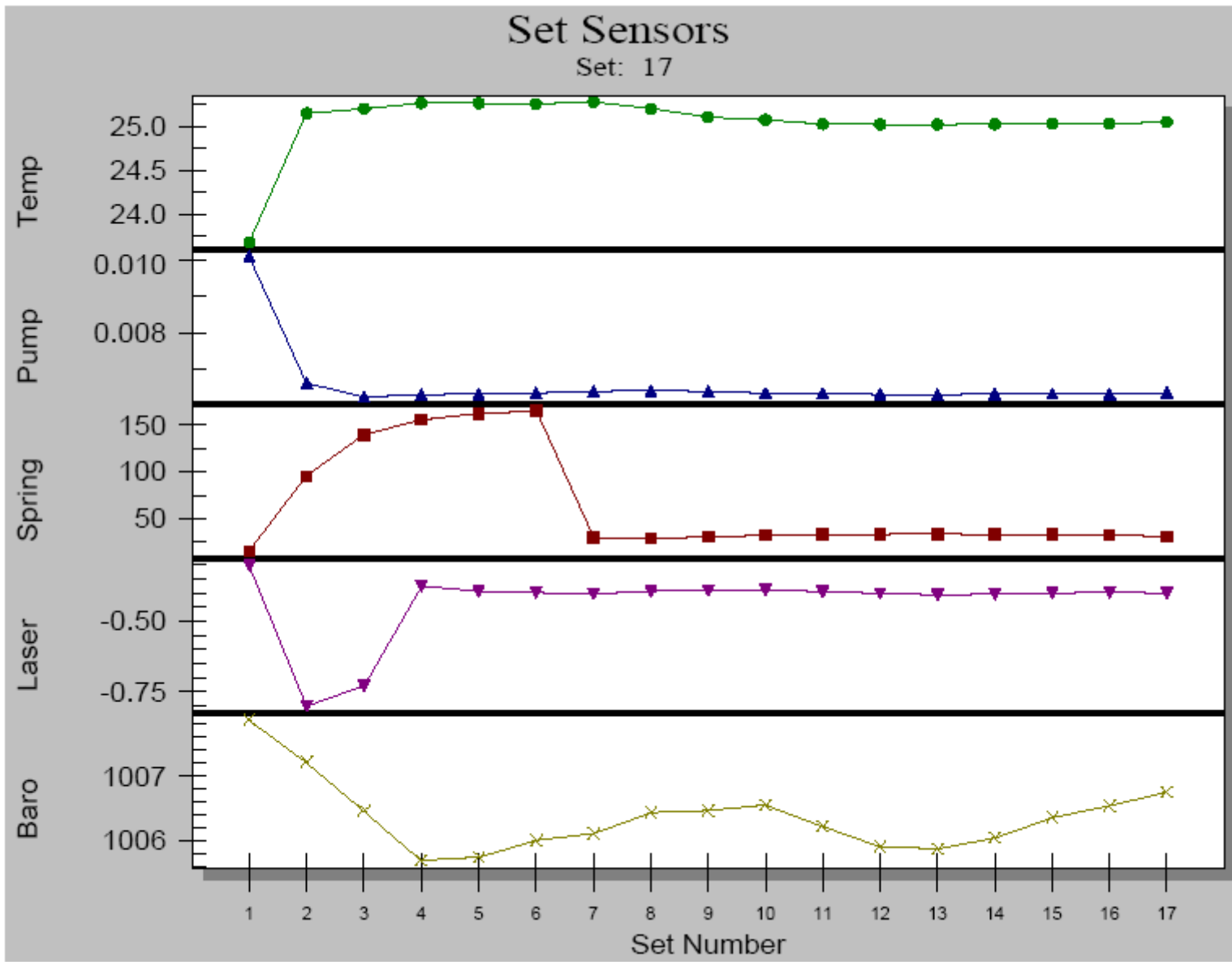
Set File

Source Data Filename: WE20060621
g Acquisition Version: 1.082300
g Processing Version: 6.060320

Set	Time	DOY	Year	Gravity	Sigma	ErrorUncert	Tide	Load	Baro	Polar	Datum	Refxo	Temp	Pres	Accept	Reject
1	14:35:26	172	2006	981309076.199	44.659	4.534	4.534	-47.235	-0.518	-1.044	-1.639	380.107	-0.002	23.677	1007.871	97 3
2	15:35:22	172	2006	981309072.852	29.573	3.050	3.050	-63.246	-0.063	-1.240	-1.639	380.107	-0.002	25.147	1007.215	94 6
3	16:35:19	172	2006	981309072.732	20.030	2.044	2.044	-71.691	0.395	-1.464	-1.639	380.107	-0.002	25.198	1006.470	96 4
4	17:35:28	172	2006	981309072.011	23.163	2.340	2.340	-73.871	0.738	-1.695	-1.639	380.107	-0.002	25.263	1005.701	98 2
5	18:35:30	172	2006	981309072.039	21.875	2.221	2.221	-72.315	0.875	-1.679	-1.639	380.107	-0.002	25.262	1005.752	97 3
6	19:35:25	172	2006	981309074.974	21.324	2.143	2.143	-70.016	0.771	-1.602	-1.639	380.107	-0.002	25.254	1006.010	99 1
7	20:35:25	172	2006	981309075.607	30.024	3.002	3.002	-69.473	0.449	-1.570	-1.639	380.107	-0.002	25.273	1006.118	100 0
8	21:35:24	172	2006	981309074.126	27.658	2.780	2.780	-71.975	-0.010	-1.474	-1.639	380.107	-0.002	25.201	1006.438	99 1
9	22:35:24	172	2006	981309074.281	22.997	2.311	2.311	-77.169	-0.490	-1.464	-1.639	380.107	-0.002	25.102	1006.472	99 1
10	23:35:25	172	2006	981309073.058	26.579	2.699	2.699	-83.058	-0.866	-1.438	-1.639	380.107	-0.002	25.071	1006.558	97 3
11	00:35:24	173	2006	981309074.271	29.837	2.999	2.999	-86.490	-1.035	-1.537	-1.639	380.107	-0.002	25.024	1006.225	99 1
12	01:35:25	173	2006	981309073.862	25.813	2.581	2.581	-84.000	-0.947	-1.631	-1.639	380.107	-0.002	25.019	1005.914	100 0
13	02:35:22	173	2006	981309072.915	36.017	3.638	3.638	-72.841	-0.613	-1.642	-1.639	380.107	-0.002	25.019	1005.877	98 2
14	03:35:25	173	2006	981309074.528	38.411	3.841	3.841	-51.843	-0.106	-1.590	-1.639	380.107	-0.002	25.022	1006.050	100 0
15	04:35:25	173	2006	981309075.011	38.637	3.864	3.864	-22.142	0.455	-1.496	-1.639	380.107	-0.002	25.027	1006.362	100 0
16	05:35:24	173	2006	981309072.012	49.002	4.925	4.925	12.911	0.937	-1.442	-1.639	380.107	-0.002	25.027	1006.545	99 1
17	06:35:26	173	2006	981309072.124	61.142	6.145	6.145	48.287	1.220	-1.378	-1.639	380.107	-0.002	25.047	1006.758	99 1







Zundert



STATION: ZUNDERT												
City:	Zundert					Country:	The Netherlands					
Location:	Fire Station					Particularity:						
Situation:	Cleaning Room					Remarks:						
Date:	15-16 June 2006											
Code number:												
Latitude:	51.5950 degrees											
Longitude:	4.7796 degrees											
Elevation:	2 m											
Gradient:	-2.993 μ gal/cm											
Reference height:	0.1265 m + 1.164 m = 1.2865 m											
Meter:	FG5											
S/N:	216											
Ocean loading correction (μgal, Greenwich degree)												
Wave	M ₂	S ₂	K ₁	O ₁	N ₂	P ₁	K ₂	Q ₁	M _f	M _m	S _{sa}	
Ampl.	1.857	0.592	0.239	0.125	0.368	0.074	0.167	0.048	0.0	0.0	0.0	
Phase:	62.2	30.1	65.2	150.6	84.4	66.5	35.3	-164.7	0.0	0.0	0.0	
Polar motion correction						Air pressure correction						
X-coordinate:	0.1260			arc seconds			Nominal air pressure:			1013.01 mbar		
Y-coordinate:	0.3162			arc seconds			Barometric admittance factor:			0.3 μ gal/mbar		
Gravity												
Set gravity mean:	9 81 196 846.7					microgal						
Set std. dev.:	1.0					microgal						
Mean std. dev.:	34.2					microgal						
Number of sets:	12											
Number of drops per set:	200											
Drop interval:	5 seconds											
Set interval:	60 minutes											
Nominal/datum height:	0.0 cm											
Author:	O. Francis					University of Luxembourg						
Date:	September 25, 2006											

Project file

Micro-g Solutions g Processing Report

File Created: 07/17/06, 09:54:07

Project Name: zu20060615

g Acquisition Version: 1.082300

g Processing Version: 6.060320

Company/Institution: ECGS

Operator: Olivier Francis

Station Data

Name: ZUNDERT

Site Code: Fire station

Lat: 51.59500 Long: 4.77960 Elev: 2.00 m

Reference Height: 12.65 cm

Datum Height: 0.00 cm

Gradient: -2.993 μ Gal/cm

Nominal Air Pressure: 1013.01 mBar

Barometric Admittance Factor: 0.30

Polar Motion Coord: 0.1260 " 0.3162 "

Earth Tide (ETGTAB) Selected

Potential Filename: C:\Program Files\Micro-g Solutions Inc\gWavefiles\Etcpot.dat

Delta Factor Filename: F:\ABSOLU\DATA\2006\zundert\OceanLoad-ZUNDERT.dff

Delta Factors

Start	Stop	Amplitude	Phase	Term
0.000000	0.002427	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: F:\ABSOLU\DATA\2006\zundert\OceanLoad-ZUNDERT.olf

Waves: M2 S2 K1 O1 N2 P1 K2 Q1 Mf Mm Ssa

Amplitude (μ Gal): 1.857 0.592 0.239 0.125 0.368 0.074 0.167 0.048 0.000 0.000 0.000

Phase (deg): 62.2 30.1 65.2 150.6 84.4 66.5 35.3 -164.7 0.0 0.0 0.0

Instrument Data

Meter Type: FG5

Meter S/N: 216

Factory Height: 116.40 cm

Rubidium Frequency: 10000000.01020 Hz

Laser: WEO100 (187)

ID: 632.99117754 nm (0.46 V)

IE: 632.99119473 nm (0.01 V)

IF: 632.99121259 nm (-0.39 V)

IG: 632.99123023 nm (-0.76 V)

IH: 632.99136890 nm (-1.53 V)

II: 632.99139822 nm (-1.38 V)

IJ: 632.99142704 nm (-1.24 V)

Modulation Frequency: 8333.420 Hz

Processing Results

Date: 06/15/06

Time: 23:09:29

DOY: 166

Year: 2006

Time Offset (D h:m:s): 0 0:0:0

Gravity: 981196846.73 μ Gal

Set Scatter: 1.01 μ Gal

Measurement Precision: 0.29 μ Gal

Total Uncertainty: 0.29 μ Gal

Number of Sets Collected: 12

Number of Sets Processed: 12

Set #s Processed: 1,2,3,4,5,6,7,8,9,10,11,12

Number of Sets NOT Processed: 0

Set #s NOT Processed:

Number of Drops/Set: 200

Total Drops Accepted: 2319

Total Drops Rejected: 81

Total Fringes Acquired: 700

Fringe Start: 7

Processed Fringes: 613

GuideCard Multiplex: 4

GuideCard Scale Factor: 250

Acquisition Settings

Set Interval: 60 min

Drop Interval: 5 sec

Number of Sets: 12

Number of Drops: 200

Gravity Corrections

Earth Tide (ETGTAB): -57.26 μ Gal

Ocean Load: -0.18 μ Gal

Polar Motion: -1.85 μ Gal

Barometric Pressure: 1.51 μ Gal

Datum Height: 386.25 μ Gal

Reference Xo: -0.00 μ Gal

Uncertainties

Sigma Reject: 3.00

Earth Tide Factor: 0.000

Average Earth Tide Uncertainty: 0.00 μ Gal

Ocean Load Factor: 0.00

Average Ocean Load Uncertainty: 0.00 μ Gal

Barometric: 0.00 μ Gal

Polar Motion: 0.00 μ Gal

Laser: 0.00 μ Gal

Clock: 0.00 μ Gal

System Type: 0.00 μ Gal

Tidal Swell: 0.00 μ Gal

Water Table: 0.00 μ Gal

Unmodeled: 0.00 μ Gal

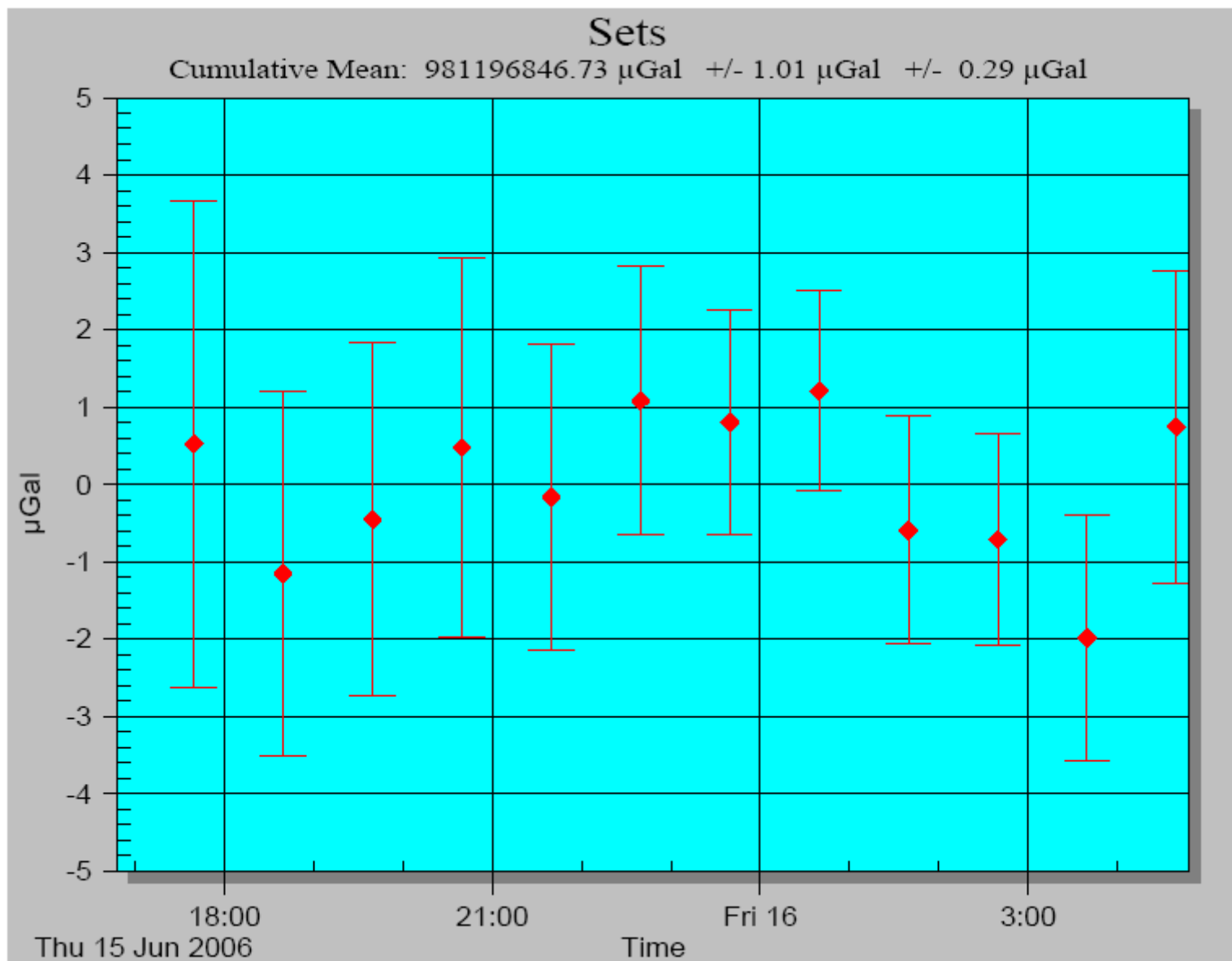
System Setup: 0.00 μ Gal

Gradient: 0.00 μ Gal (0.00 μ Gal/cm)

Set File

Source Data Filename: zu20060615
g Acquisition Version: 1.082300
g Processing Version: 6.060320

Set	Time	DOY	Year	Gravity	Sigma	ErrorUncert	Tide	Load	Baro	Polar	Datum	Refxo	Temp	Pres	Accept	Reject
1	17:39:23	166	2006	981196847.248	44.291	3.148	3.148	32.869	-2.235	1.406	-1.849	386.247	-0.002	29.266	1017.698	198 2
2	18:39:23	166	2006	981196845.574	33.143	2.361	2.361	-1.691	-2.409	1.473	-1.849	386.247	-0.002	29.867	1017.920	197 3
3	19:39:36	166	2006	981196846.269	31.457	2.282	2.282	-34.642	-2.060	1.482	-1.849	386.247	-0.002	30.008	1017.951	190 10
4	20:39:33	166	2006	981196847.204	33.880	2.445	2.445	-61.438	-1.288	1.529	-1.849	386.247	-0.002	29.987	1018.107	192 8
5	21:39:31	166	2006	981196846.558	27.365	1.980	1.980	-79.524	-0.286	1.576	-1.849	386.247	-0.002	29.973	1018.263	191 9
6	22:39:30	166	2006	981196847.804	24.148	1.734	1.734	-88.194	0.701	1.569	-1.849	386.247	-0.002	29.950	1018.241	194 6
7	23:39:27	166	2006	981196847.527	20.447	1.461	1.461	-88.700	1.436	1.543	-1.849	386.247	-0.002	29.892	1018.154	196 4
8	00:39:31	167	2006	981196847.935	17.963	1.290	1.290	-83.756	1.756	1.534	-1.849	386.247	-0.002	29.831	1018.122	194 6
9	01:39:29	167	2006	981196846.134	20.559	1.472	1.472	-76.739	1.601	1.482	-1.849	386.247	-0.002	29.777	1017.950	195 5
10	02:39:30	167	2006	981196846.015	18.630	1.362	1.362	-70.674	1.036	1.537	-1.849	386.247	-0.002	29.710	1018.132	187 13
11	03:39:31	167	2006	981196844.741	21.883	1.592	1.592	-67.424	0.227	1.479	-1.849	386.247	-0.002	29.615	1017.939	189 11
12	04:39:22	167	2006	981196847.470	28.333	2.024	2.024	-67.171	-0.598	1.459	-1.849	386.247	-0.002	29.459	1017.873	196 4



Set Corrections

Set: 12

