



FIRST ABSOLUTE GRAVITY MEASUREMENTS IN HAITI DURING NOVEMBER 2016

Preliminary Report

Prof. Dr. Olivier Francis

*University of Luxembourg
Faculty of Sciences, Technology and Communication
Campus Kirchberg
6, rue Coudenhove-Kalergi
L-1359 Luxembourg
Grand-Duché de Luxembourg*

Tel. : +352 46 66 44 6264, Email : Olivier.francis@uni.lu

January 2017

Foreword

This report contains the preliminary results of absolute gravity measurements carried out in Haiti in November 2016. For this specific project, a scientific convention was signed between the Faculty of Sciences, Technology and Communication of the University of Luxembourg and the "Unité de Recherche en Géophysique" (URGéo) from the Faculty of Sciences of the State University of Haiti. In short, the Geophysics Laboratory of the UL is bringing an absolute gravimeter and all the necessary equipment as well as an experimented operator. The URGéo is responsible for all the logistic in Haiti. The project consists in establishing a network of absolute gravity stations nearby the permanent GPS stations of the Centre National de l'Information Géo-Spatiale (CNIIGS) (Figure 1).



Figure 1. Locations of the permanent GPS stations (yellow) of the CNIIGS and of the established absolute gravity stations (red).

The scientific objectives are:

1. Monitoring of the crust deformations related to tectonic motions,
2. Determination of the geophysical process by comparing the rates of the gravity changes to the vertical displacements,
3. Monitoring of the vertical displacements at the tide gauge stations in parallel with the continuous GPS observations,
4. Establishment of the zero order network in gravity that will be the reference (and can be used to calibrate) all future gravity survey in Haiti.

The planned gravity stations are about 16. They are all collocated with a GPS station from the Haitian permanent GPS network. During the construction of the GPS sites, concrete pillars 1m x 1m were also built inside the stations enclosure.

Our intention was to occupy 8 to 9 stations during this first campaign: a fundamental station in Port-au-Prince at the CNIIGS and most of the stations in the South of the country. Unfortunately, a fatal crash of the computer controlling the absolute gravimeter forced us to stop the campaign. However, excellent measurements were obtained at three stations. This short campaign gave us the opportunity to test the equipment and the team. Actions are underway to make the equipment more robust. The campaign will be resumed within a year at the latest in January-February 2018.

All the measurements were carried out with the FG5X-216 from the University of Luxembourg. The gravimeter was operated by Olivier Francis with the assistance of Renaldo Sauveur who was in charge of the field trip.

During this first campaign, the vertical gravity gradients were not measured. This will be done during the next campaign planned for January-February 2018.

This report is still preliminary as we have to measure the vertical gravity gradients. We also need the best possible values for the elevations at the stations. This information is crucial for an accurate determination of the g-values.

This project would not have been achieved without the strong support and collaboration of Boby Emmanuel Piard, Renaldo Sauveur and Jean Beker Neptune from the CNIIGS, Dominique Boisson and Kelly Guerrier from the URGéo, and finally Sylvain Rochenel from the Laboratoire National du Batiment et des Travaux Publics (LNBTP). Last but not least, the drivers demonstrated an exceptional professionalism in their driving. They never hesitated to give a strong hand when necessary. All the participants are thanked for their warm hospitality and help during our measurements.

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 Vertical Gravity Gradient (VGG).

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 effect using a constant admittance, and the polar motion effect using pole positions from the International Earth Rotation Service (<http://hpiers.obspm.fr>).

The g-soft version 9.120423 software from Microg-LaCoste 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 is needed to linearize the equation of motion but also to transfer the measured absolute gravity value from the reference height around 1.38 m to the floor. Its determination requires relative measurements using a smaller and portable relative gravimeter. As the VGG still needs to be measured with relative gravity meters, we used a standard value of 3 microgal/cm. During the next campaign, the VGG will be measured with a Scintrex and the observed values will be used to reprocessed the data.

Results of the absolute gravity measurements

The FG5X#216 operated from Tuesday 8th of November until Friday 11th of November 2016. A total of 48 sets (17 sets at Port-au Prince and Fond-des-Blancs, 14 sets at Jacmel) of 200 drops every 5 seconds were taken at a rate of 1 set per hour. It represents a total of 9600 drops.

The final results for each station are given in table 1 with the associated uncertainty.

Table 1. Absolute gravity values at the three newly established stations in Haiti. The g -values are given at the floor level, i.e. on the top of the benchmark.

Site	Date	Gravity value / μ Gal @ 0 m	Mean Set Standard Deviation / μ Gal
Port-au-Prince	09/11/2016	978 565 468.3	1.0
Jacmel	10/11/2016	978 632 674.9	0.7
Fond-des-Blancs	11/11/2016	978 574 601.1	0.8

Future work

During the next campaign planned for January 2017, absolute gravity stations will be established at the dozens of other permanent GPS stations of the Haitian network. The vertical gravity gradient will be measured at all the stations of the network. Precise elevations of all the stations are needed from the data processing.

Reference

Francis O., van Dam T.M., Processing of the Absolute data of the ICA001, Cahiers du Centre Européen de Géodynamique et de Séismologie, vol.22, 45-48, 2003. <https://doi.org/10.5281/zenodo.7890604>

PORT-AU-PRINCE



STATION: PORT-AU-PRINCE												
City:	Port-au-Prince					Country:	Haiti					
Location:	CNIGS					Particularity:						
Situation:	New building					Remarks:	1 st floor next to the stairs					
Date:	9 November 2016											
Code number:												
Latitude:	18.52975					degrees						
Longitude:	-72.32361					degrees						
Elevation:	130.0					m						
Gradient:	-3.0					µgal/cm						
Reference height:	1.3198					m						
Meter:	FG5X											
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. :	1.728	0.556	0.883	0.716	0.321	0.266	0.157	0.169	0.0	0.0	0.0	
Phase:	11.9	-27.1	30.2	33.2	34.8	26.9	-23.1	41.1	0.0	0.0	0.0	
Polar motion correction						Air pressure correction						
X-coordinate:	0.1736			Arc seconds			Nominal air pressure:			997.73 mbar		
Y-coordinate:	0.2777			Arc seconds			Barometric admittance factor:			0.3 µgal/mbar		
Gravity												
Set gravity mean:	978 564 468.30					microgal						
Set std. dev.:	1.02					microgal						
Mean std. dev.:	9.88					microgal						
Number of sets:	17											
Number of drops per set:	200											
Drop interval:	5					second						
Set interval:	60					minute						
Nominal/datum height:	0.00					m						
Author:	O. Francis					University of Luxembourg						
Date:	January 6,2017											

Project file

Micro-g LaCoste g Processing Report
File Created: 01/05/17, 13:42:46

Project Name: PP20161108
g Acquisition Version: 9.110914
g Processing Version: 9.120423

Company/Institution: University of Luxembourg
Operator: Olivier Francis

Station Data

Name: Port-au-Prince
Site Code: CNIGS
Lat: 18.52975 Long: -72.32361 Elev: 130.00 m
Setup Height: 6.15 cm
Transfer Height: 0.00 cm
Actual Height: 131.98 cm
Gradient: -3.000 μ Gal/cm
Nominal Air Pressure: 997.73 mBar
Barometric Admittance Factor: 0.30
Polar Motion Coord: 0.1736 " 0.2777 "
Earth Tide (ETGTAB) Selected
Potential Filename: C:\gData\gWavefiles\ETCPOT.dat
Delta Factor Filename: C:\DATA\ABSOLU\DATA\INI\OceanLoad-Port-au-Prince.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: C:\DATA\ABSOLU\DATA\INI\OceanLoad-Port-au-Prince.olf

Waves: M2 S2 K1 O1 N2 P1 K2 Q1 Mf Mm Ssa
Amplitude (μ Gal): 1.728 0.556 0.883 0.716 0.321 0.266 0.157 0.169 0.000 0.000 0.000
Phase (deg): 11.9 -27.1 30.2 33.2 34.8 26.9 -23.1 41.1 0.0 0.0 0.0

Instrument Data

Meter Type: FG5
Meter S/N: 216
Factory Height: 125.83 cm
Rubidium Frequency: 10000000.00000 Hz
Laser: WEO100 (242)
ID: 632.99117754 nm (0.01 V)
IE: 632.99119473 nm (-0.46 V)
IF: 632.99121259 nm (-0.84 V)
IG: 632.99123023 nm (-1.19 V)
IH: 632.99136890 nm (-1.61 V)
II: 632.99139822 nm (-1.32 V)
IJ: 632.99142704 nm (-1.05 V)
Modulation Frequency: 8333.340 Hz

Processing Results

Date: 11/09/16
Time: 08:16:58
DOY: 314
Year: 2016
Time Offset (D h:m:s): 0 0:0:0
Gravity: 978565468.30 μ Gal
Set Scatter: 1.02 μ Gal

Measurement Precision: 0.25 μ Gal
Total Uncertainty: 4.38 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: 200
Total Drops Accepted: 3389
Total Drops Rejected: 11
Total Fringes Acquired: 1100
Fringe Start: 2
Processed Fringes: 1030
GuideCard Multiplex: 4
GuideCard Scale Factor: 250

Acquisition Settings

Set Interval: 60 min
Drop Interval: 5 sec
Number of Sets: 24
Number of Drops: 200

Gravity Corrections

Earth Tide (ETGTAB): 42.62 μ Gal
Ocean Load: 0.27 μ Gal
Polar Motion: -3.66 μ Gal
Barometric Pressure: -0.47 μ Gal
Transfer Height: 395.94 μ Gal
Reference Xo: 0.00 μ Gal

Set File

Source Data Filename: PP20161108

g Acquisition Version: 9.110914

g Processing Version: 9.120423

Set	Time	DOY	Year	Gravity	Sigma	Error	Uncert	Tide	Load	Baro	Polar	Transfer	Refxo	Tilt	Diffraction	SelfAttract	Temp	Pres	Chan5	Chan6	Chan7	Chan8	Chan9	Chan10	Accept	Reject
1	00:16:58314	2016	978565469.264	10.839	0.770	4.443	73.536	0.521	-0.611	-3.660	395.940	0.003	0.000	0.000	0.000	39.821	995.694	-0.003	293.601	211.737	0.000	0.000	0.000	198	2	
2	01:16:58314	2016	978565469.292	10.333	0.731	4.436	74.383	0.256	-0.440	-3.660	395.940	0.004	0.000	0.000	0.000	40.195	996.263	-0.002	234.500	161.855	0.000	0.000	0.000	200	0	
3	02:16:58314	2016	978565466.889	10.222	0.723	4.435	60.895	-0.099	-0.378	-3.660	395.940	0.004	0.000	0.000	0.000	40.320	996.471	-0.001	230.435	161.710	0.000	0.000	0.000	200	0	
4	03:16:58314	2016	978565470.169	9.866	0.698	4.431	37.369	-0.421	-0.313	-3.660	395.940	0.004	0.000	0.000	0.000	40.059	996.686	-0.001	250.375	176.585	0.000	0.000	0.000	200	0	
5	04:16:58314	2016	978565467.980	9.855	0.697	4.431	10.679	-0.598	-0.425	-3.660	395.940	0.003	0.000	0.000	0.000	40.087	996.313	-0.001	250.920	175.285	0.000	0.000	0.000	200	0	
6	05:16:58314	2016	978565469.133	10.671	0.755	4.440	-11.596	-0.556	-0.513	-3.660	395.940	0.003	0.000	0.000	0.000	39.846	996.021	-0.001	243.660	165.020	0.000	0.000	0.000	200	0	
7	06:16:58314	2016	978565467.821	8.509	0.602	4.416	-23.115	-0.280	-0.571	-3.660	395.940	0.004	0.000	0.000	0.000	39.659	995.827	-0.000	247.645	164.695	0.000	0.000	0.000	200	0	
8	07:16:58314	2016	978565467.532	10.333	0.731	4.436	-20.335	0.184	-0.710	-3.660	395.940	0.003	0.000	0.000	0.000	40.044	995.362	-0.000	234.670	152.330	0.000	0.000	0.000	200	0	
9	08:16:58314	2016	978565467.900	9.389	0.666	4.426	-3.329	0.733	-0.695	-3.660	395.940	0.003	0.000	0.000	0.000	40.161	995.412	-0.001	238.251	157.648	0.000	0.000	0.000	199	1	
10	09:16:58314	2016	978565469.580	8.216	0.581	4.415	24.266	1.235	-0.651	-3.660	395.940	0.004	0.000	0.000	0.000	39.908	995.558	-0.001	203.630	121.625	0.000	0.000	0.000	200	0	
11	10:17:00314	2016	978565466.746	9.405	0.667	4.429	56.037	1.562	-0.571	-3.660	395.940	0.003	0.000	0.000	0.000	39.658	995.826	-0.001	208.090	122.543	0.000	0.000	0.000	199	1	
12	11:16:56314	2016	978565469.231	9.230	0.658	4.428	84.194	1.618	-0.420	-3.660	395.940	0.003	0.000	0.000	0.000	39.993	996.328	-0.001	214.117	129.391	0.000	0.000	0.000	197	3	
13	12:16:58314	2016	978565467.715	9.262	0.657	4.427	101.521	1.366	-0.299	-3.660	395.940	0.003	0.000	0.000	0.000	40.061	996.734	-0.001	211.965	123.337	0.000	0.000	0.000	199	1	
14	13:16:58314	2016	978565467.901	10.454	0.739	4.439	102.830	0.838	-0.145	-3.660	395.940	0.003	0.000	0.000	0.000	40.365	997.245	-0.001	220.865	133.310	0.000	0.000	0.000	200	0	
15	14:16:58314	2016	978565467.977	10.440	0.738	4.438	86.542	0.132	-0.236	-3.660	395.940	0.003	0.000	0.000	0.000	40.492	996.945	-0.001	203.380	117.740	0.000	0.000	0.000	200	0	
16	15:16:59314	2016	978565468.933	10.047	0.714	4.434	55.231	-0.612	-0.427	-3.660	395.940	0.003	0.000	0.000	0.000	40.288	996.308	-0.001	206.758	121.242	0.000	0.000	0.000	198	2	
17	16:16:57314	2016	978565466.590	10.959	0.777	4.445	15.396	-1.240	-0.643	-3.660	395.940	0.003	0.000	0.000	0.000	40.361	995.586	-0.001	205.201	119.402	0.000	0.000	0.000	199	1	

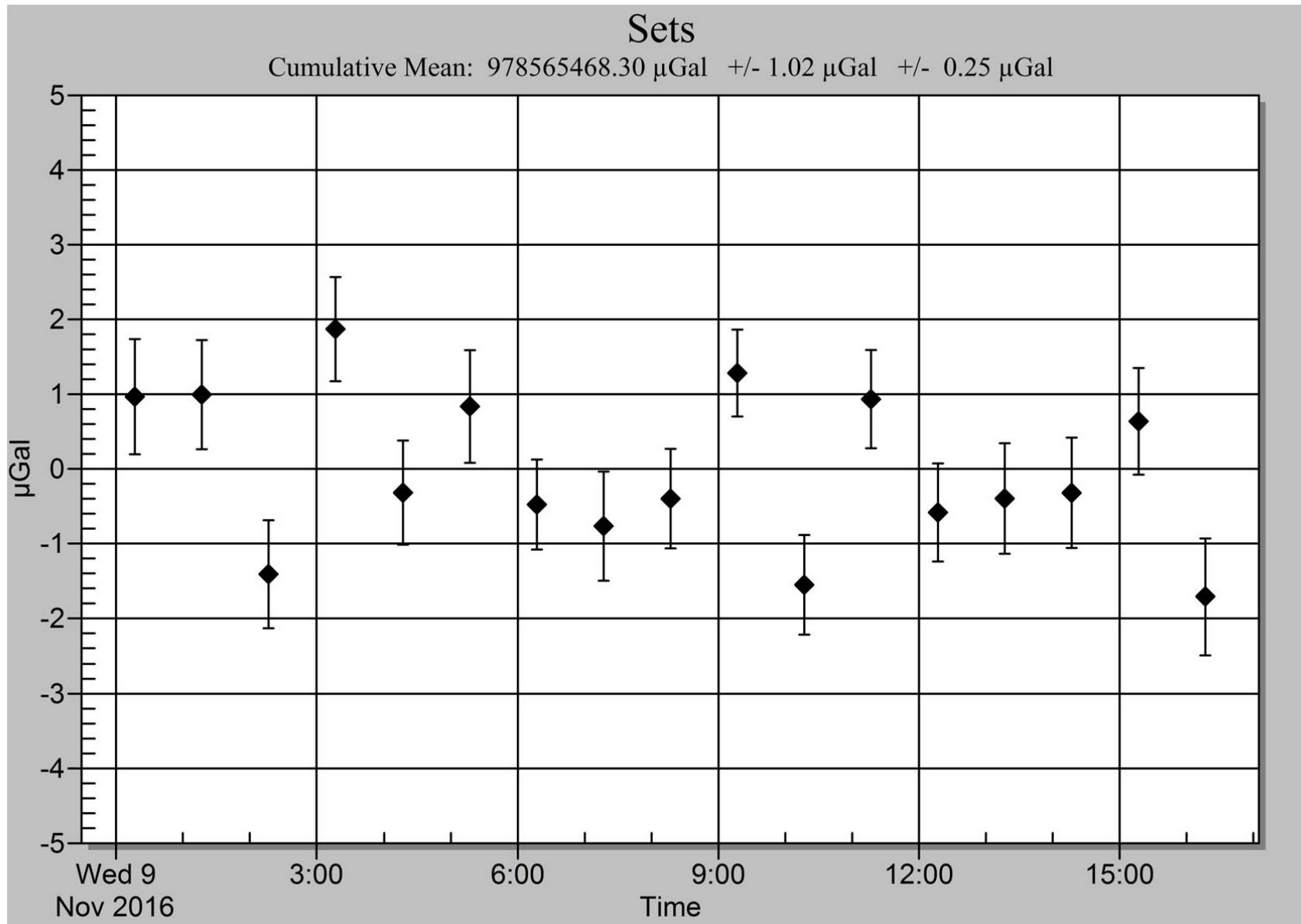


Figure 2. Plot of the set gravity values (1 set = 200 drops).

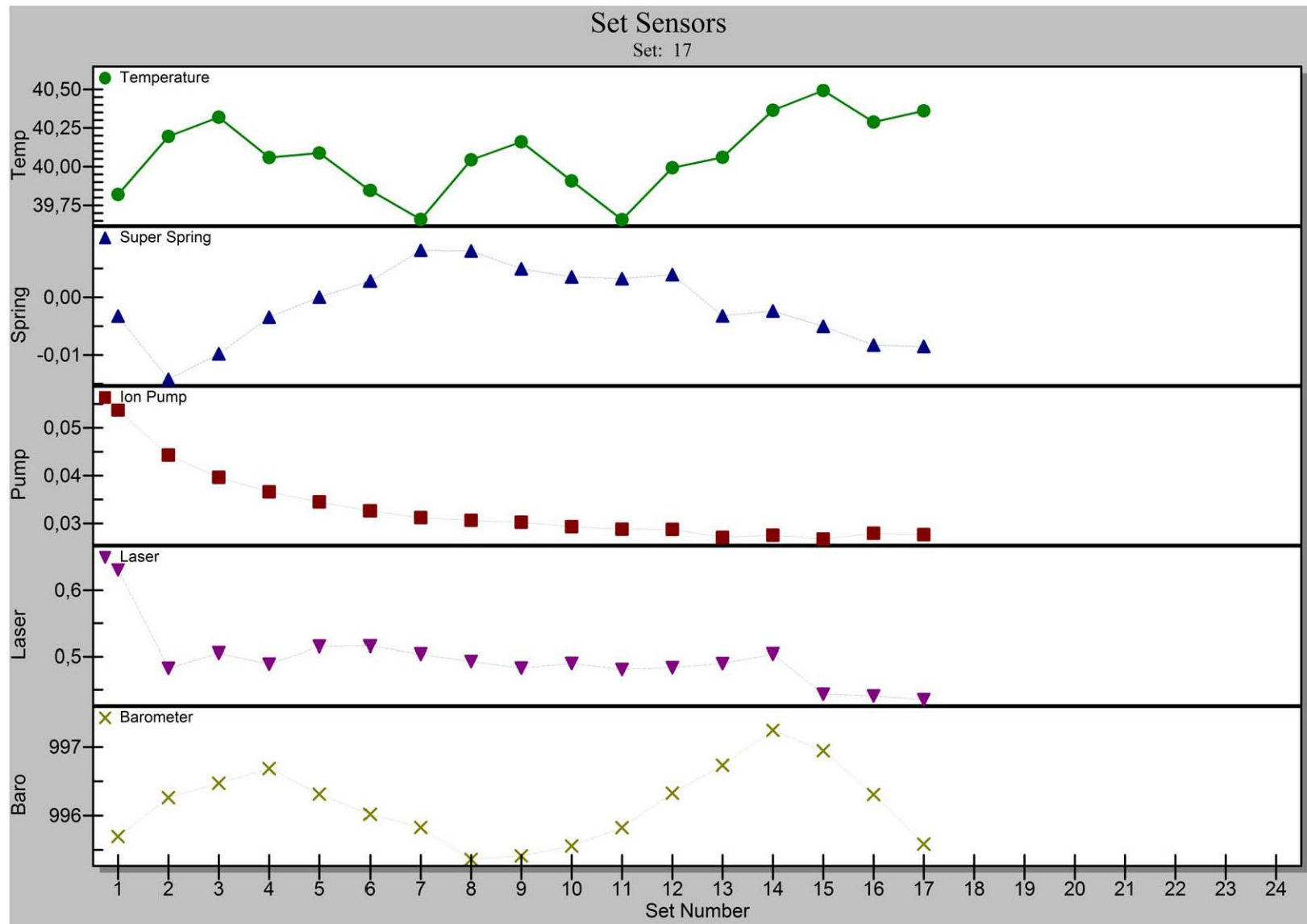


Figure 3. Plot of the set sensor data (1 set = 200 drops).

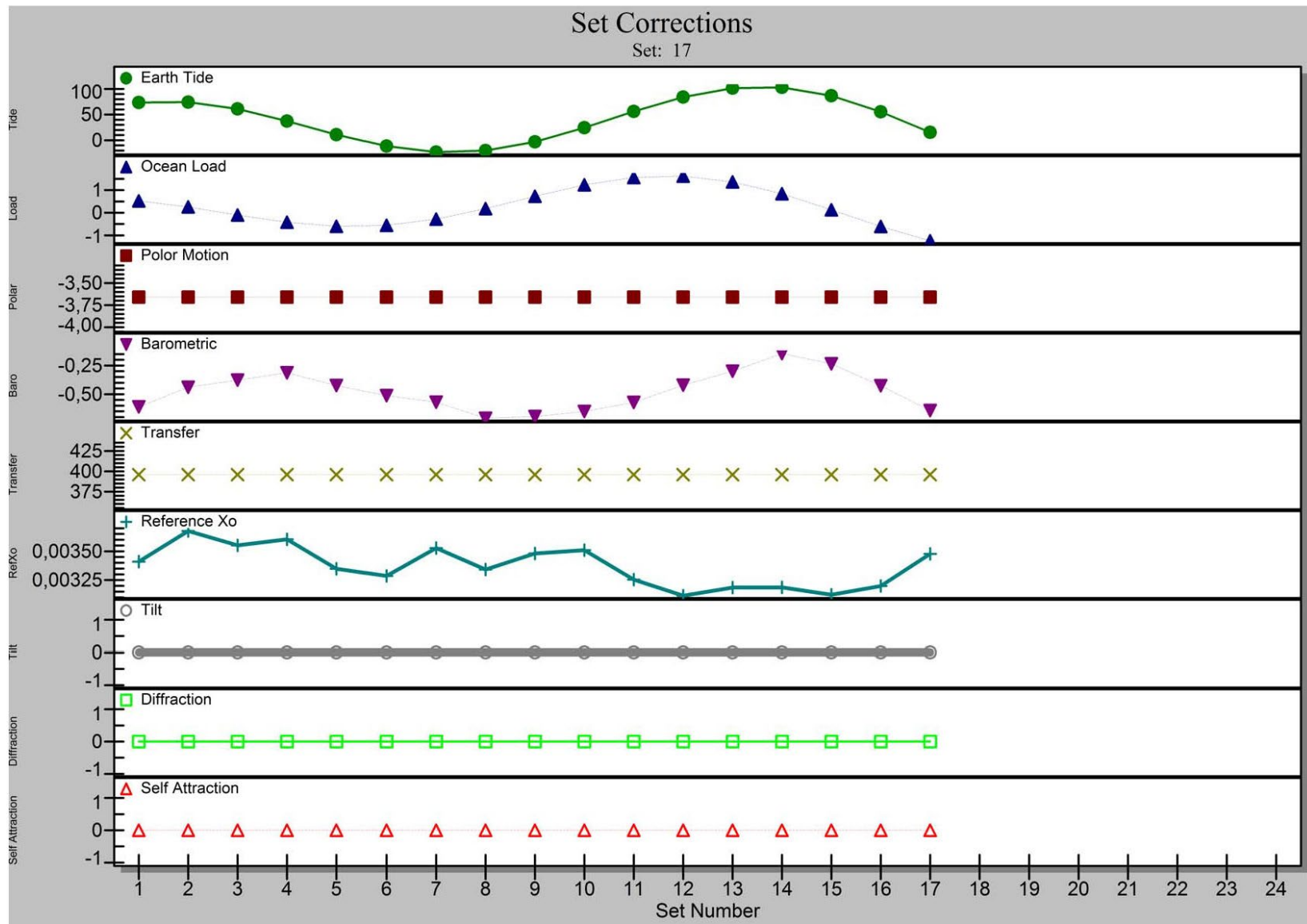


Figure 4. Plot of the set corrections values (1 set = 200 drops).

JACMEL



STATION: JACMEL											
City:	Jacmel					Country:	Haiti				
Location:	Permanent GPS CNIGS					Particularity:					
Situation:	Airport					Remarks:					
Date:	10 November 2016										
Code number:											
Latitude:	18.23778					degrees					
Longitude:	-72.51777					degrees					
Elevation:	45					m					
Gradient:	-3.0					µgal/cm					
Reference height:	1.3738					m					
Meter:	FG5X										
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. :	1.669	0.561	0.902	0.724	0.304	0.271	0.157	0.171	0.0	0.0	0.0
Phase:	15.7	-25.7	29.6	32.8	39.5	25.6	-21.6	40.7	0.0	0.0	0.0
Polar motion correction						Air pressure correction					
X-coordinate:	0.1713		Arc seconds			Nominal air pressure:				1007.86 mbar	
Y-coordinate:	0.2764		Arc seconds			Barometric admittance factor:				0.3 µgal/mbar	
Gravity											
Set gravity mean:	978 632 674.93					microgal					
Set std. dev.:	0.65					microgal					
Mean std. dev.:	11.33					microgal					
Number of sets:	14										
Number of drops per set:	200										
Drop interval:	5					second					
Set interval:	60					minute					
Nominal/datum height:	0.00					m					
Author: O. Francis	University of Luxembourg										
Date: January 6,2017											

Project file

Micro-g LaCoste g Processing Report
File Created: 01/05/17, 14:40:06

Project Name: JA20161109
g Acquisition Version: 9.110914
g Processing Version: 9.120423

Company/Institution: University of Luxembourg
Operator: Olivier Francis

Station Data

Name: JACMEL
Site Code: Aeroport
Lat: 18.23778 Long: -72.51777 Elev: 45.00 m
Setup Height: 11.55 cm
Transfer Height: 0.00 cm
Actual Height: 137.38 cm
Gradient: -3.000 μ Gal/cm
Nominal Air Pressure: 1007.86 mBar
Barometric Admittance Factor: 0.30
Polar Motion Coord: 0.1713 " 0.2764 "
Earth Tide (ETGTAB) Selected
Potential Filename: C:\gData\gWavefiles\ETCPOT.dat
Delta Factor Filename: C:\DATA\ABSOLU\DATA\INI\OceanLoad-JACMEL.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: C:\DATA\ABSOLU\DATA\INI\OceanLoad-JACMEL.olf

Waves: M2 S2 K1 O1 N2 P1 K2 Q1 Mf Mm Ssa
Amplitude (μ Gal): 1.669 0.561 0.902 0.724 0.304 0.271 0.157 0.171 0.000 0.000 0.000
Phase (deg): 15.7 -25.7 29.6 32.8 39.5 25.6 -21.6 40.7 0.0 0.0 0.0

Instrument Data

Meter Type: FG5
Meter S/N: 216
Factory Height: 125.83 cm
Rubidium Frequency: 10000000.00000 Hz
Laser: WEO100 (242)
ID: 632.99117754 nm (0.90 V)
IE: 632.99119473 nm (0.50 V)
IF: 632.99121259 nm (0.00 V)
IG: 632.99123023 nm (-1.19 V)
IH: 632.99136890 nm (-1.61 V)
II: 632.99139822 nm (-1.32 V)
IJ: 632.99142704 nm (-1.05 V)
Modulation Frequency: 8333.340 Hz

Processing Results

Date: 11/10/16
Time: 07:23:27
DOY: 315
Year: 2016
Time Offset (D h:m:s): 0 0:0:0
Gravity: 978632674.93 μ Gal
Set Scatter: 0.65 μ Gal
Measurement Precision: 0.17 μ Gal
Total Uncertainty: 0.17 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: 2775
Total Drops Rejected: 25
Total Fringes Acquired: 1100
Fringe Start: 2
Processed Fringes: 1030
GuideCard Multiplex: 4
GuideCard Scale Factor: 250

Acquisition Settings
Set Interval: 60 min
Drop Interval: 5 sec
Number of Sets: 24
Number of Drops: 200

Gravity Corrections
Earth Tide (ETGTAB): 43.68 μ Gal
Ocean Load: 0.29 μ Gal
Polar Motion: -3.59 μ Gal
Barometric Pressure: -0.20 μ Gal
Transfer Height: 412.14 μ Gal
Reference Xo: 0.00 μ Gal

Set File

Source Data Filename: JA20161109
 g Acquisition Version: 9.110914
 g Processing Version: 9.120423

Set	Time	DOY	Year	Gravity	Sigma	Error	Uncert	Tide	Load	Baro	Polar	Transfer	Refxo	Tilt	Diffraction	SelfAttract	Temp	Pres	Chan5	Chan6	Chan7	Chan8	Chan9	Chan10	Accept	Reject
1	00:53:29315	2016	978632677.084	22.461	1.592	1.592	105.312	0.924	-0.178	-3.586	412.140	0.003	0.000	0.000	0.000	39.653	1007.268	-0.001	908.352	1108.910	0.000	0.000	0.000	199	1	
2	01:53:30315	2016	978632674.268	12.478	0.885	0.885	110.430	0.661	-0.145	-3.586	412.140	0.003	0.000	0.000	0.000	41.068	1007.376	-0.002	623.523	645.643	0.000	0.000	0.000	199	1	
3	02:53:24315	2016	978632676.033	11.069	0.793	0.793	94.282	0.223	-0.063	-3.586	412.140	0.003	0.000	0.000	0.000	41.061	1007.650	-0.001	541.472	523.133	0.000	0.000	0.000	195	5	
4	03:53:28315	2016	978632674.289	12.564	0.888	0.888	61.472	-0.269	-0.060	-3.586	412.140	0.004	0.000	0.000	0.000	40.822	1007.661	-0.001	474.560	433.705	0.000	0.000	0.000	200	0	
5	04:53:26315	2016	978632674.550	11.202	0.798	0.798	21.057	-0.675	-0.155	-3.586	412.140	0.003	0.000	0.000	0.000	40.714	1007.344	-0.001	485.594	442.807	0.000	0.000	0.000	197	3	
6	05:53:28315	2016	978632674.720	11.207	0.792	0.792	-16.342	-0.881	-0.328	-3.586	412.140	0.003	0.000	0.000	0.000	40.379	1006.767	-0.000	458.470	399.610	0.000	0.000	0.000	200	0	
7	06:53:28315	2016	978632673.963	10.995	0.777	0.777	-40.900	-0.821	-0.496	-3.586	412.140	0.004	0.000	0.000	0.000	39.770	1006.206	0.000	466.555	404.640	0.000	0.000	0.000	200	0	
8	07:53:26315	2016	978632675.720	11.163	0.791	0.791	-46.289	-0.499	-0.556	-3.586	412.140	0.003	0.000	0.000	0.000	39.566	1006.007	0.000	459.412	389.065	0.000	0.000	0.000	199	1	
9	08:53:27315	2016	978632675.312	11.077	0.785	0.785	-31.042	0.011	-0.499	-3.586	412.140	0.004	0.000	0.000	0.000	39.053	1006.196	0.001	417.246	333.266	0.000	0.000	0.000	199	1	
10	09:53:28315	2016	978632674.425	10.060	0.711	0.711	1.143	0.585	-0.386	-3.586	412.140	0.003	0.000	0.000	0.000	38.821	1006.573	0.000	424.755	339.210	0.000	0.000	0.000	200	0	
11	10:53:30315	2016	978632674.802	9.440	0.669	0.669	42.271	1.076	-0.152	-3.586	412.140	0.003	0.000	0.000	0.000	38.699	1007.352	-0.000	383.588	295.392	0.000	0.000	0.000	199	1	
12	11:53:28315	2016	978632675.488	10.394	0.735	0.735	81.946	1.351	0.013	-3.586	412.140	0.004	0.000	0.000	0.000	39.985	1007.904	-0.000	305.205	212.915	0.000	0.000	0.000	200	0	
13	12:53:25315	2016	978632674.942	10.886	0.774	0.774	109.875	1.328	0.038	-3.586	412.140	0.003	0.000	0.000	0.000	43.145	1007.986	-0.004	184.475	120.222	0.000	0.000	0.000	198	2	
14	13:53:14315	2016	978632674.971	14.693	1.066	1.066	118.369	0.995	0.138	-3.586	412.140	0.004	0.000	0.000	0.000	46.490	1008.320	0.004	143.521	88.479	0.000	0.000	0.000	190	10	

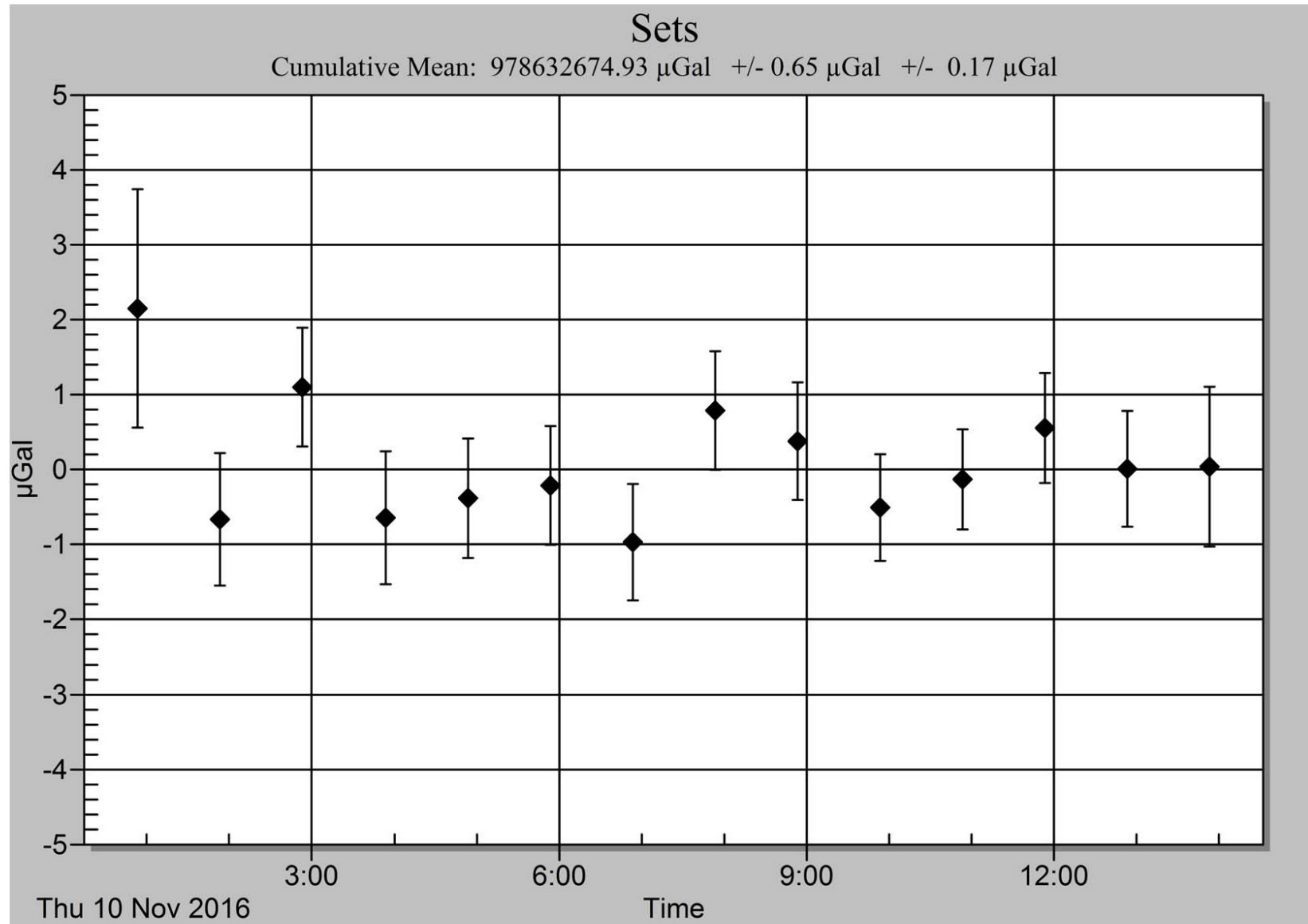


Figure 2. Plot of the set gravity values (1 set = 200 drops).

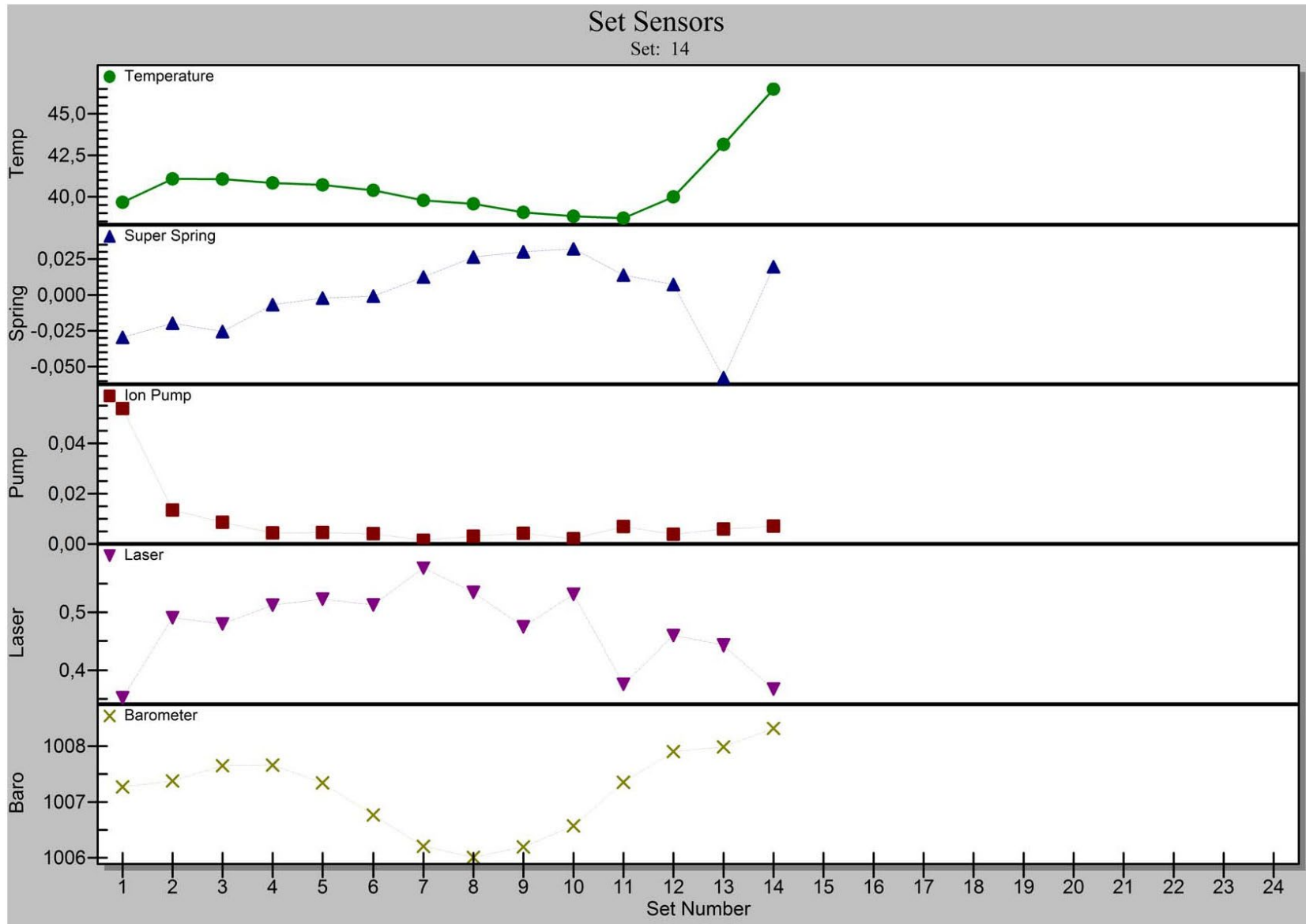


Figure 3. Plot of the set sensor data (1 set = 200 drops).

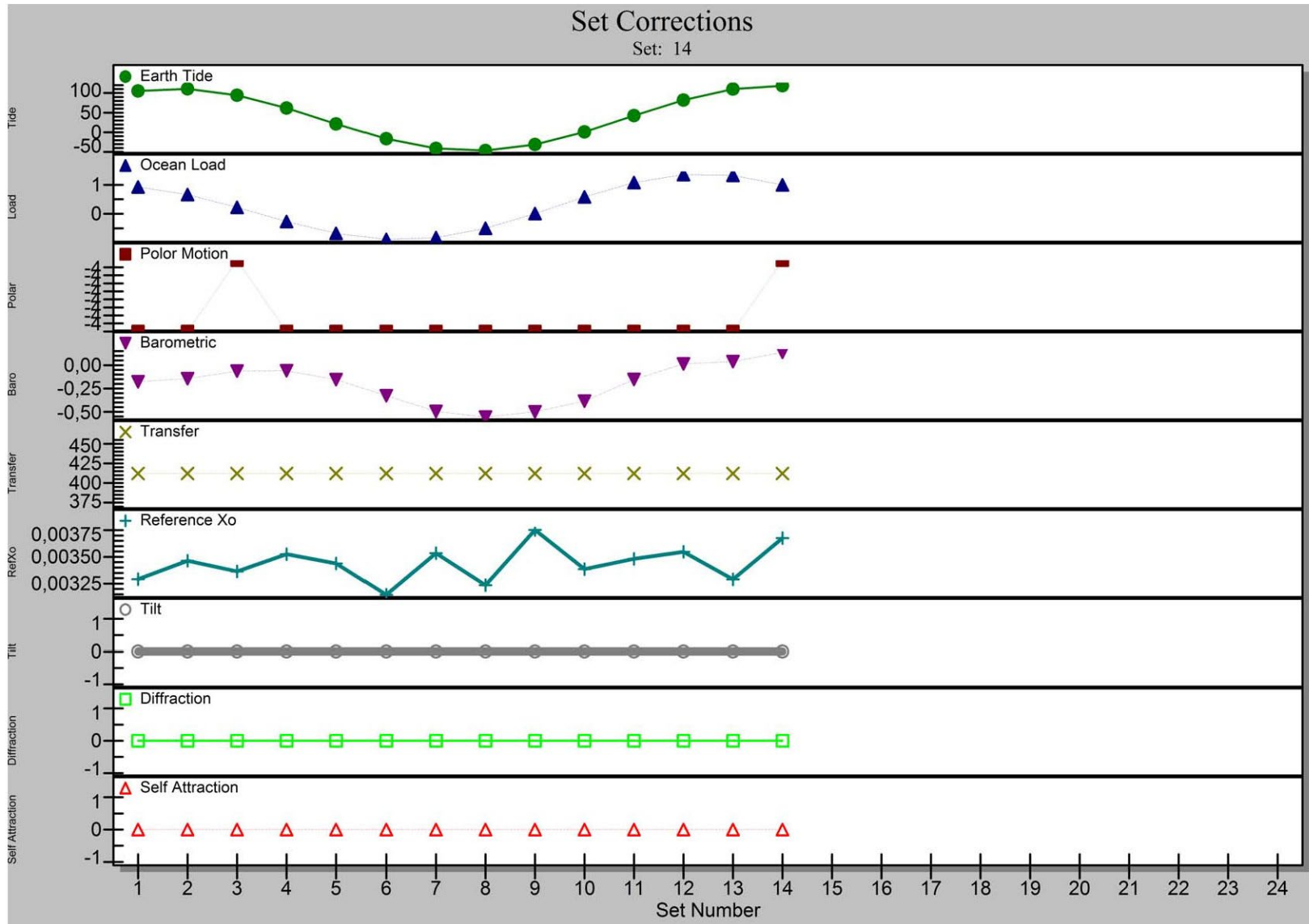


Figure 4. Plot of the set corrections values (1 set = 200 drops).

FOND-DES-BLANCS



STATION: FOND-DES-BLANCS											
City:	Fond-des-Blancs					Country:	Haiti				
Location:	Permanent GPS CNIGS					Particularity:					
Situation:	Moron					Remarks:					
Date:	11 November 2016										
Code number:											
Latitude:	18.29797					degrees					
Longitude:	-73.10384					degrees					
Elevation:	352					m					
Gradient:	-3.0					µgal/cm					
Reference height:	137.73					m					
Meter:	FG5X										
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. :	1.648	0.577	0.908	0.723	0.294	0.272	0.161	0.171	0.0	0.0	0.0
Phase:	15.1	-26.5	30.5	33.4	38.7	26.2	-22.2	40.8	0.0	0.0	0.0
Polar motion correction						Air pressure correction					
X-coordinate:	0.1736		Arc seconds			Nominal air pressure:			997.73 mbar		
Y-coordinate:	0.2777		Arc seconds			Barometric admittance factor:			0.3 µgal/mbar		
Gravity											
Set gravity mean:	978 574 601.13					microgal					
Set std. dev.:	0.84					microgal					
Mean std. dev.:	7.65					microgal					
Number of sets:	17										
Number of drops per set:	200										
Drop interval:	5					second					
Set interval:	60					minute					
Nominal/datum height:	0.00					m					
Author: O. Francis	University of Luxembourg										
Date: January 6,2017											

Project file

Micro-g LaCoste g Processing Report
File Created: 01/06/17, 13:01:03

Project Name: FB20161110
g Acquisition Version: 9.110914
g Processing Version: 9.120423

Company/Institution: University of Luxembourg
Operator: Olivier Francis

Station Data

Name: FONDS DES BLANCS
Site Code: GPS
Lat: 18.29797 Long: -73.10384 Elev: 352.00 m
Setup Height: 11.90 cm
Transfer Height: 0.00 cm
Actual Height: 137.73 cm
Gradient: -3.000 μ Gal/cm
Nominal Air Pressure: 971.67 mBar
Barometric Admittance Factor: 0.30
Polar Motion Coord: 0.1694 " 0.2764 "
Earth Tide (ETGTAB) Selected
Potential Filename: C:\gData\gWavefiles\ETCPOT.dat
Delta Factor Filename: C:\DATA\ABSOLU\DATA\INI\OceanLoad-FONDS DES BLANCS.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: C:\DATA\ABSOLU\DATA\INI\OceanLoad-FONDS DES BLANCS.olf
Waves: M2 S2 K1 O1 N2 P1 K2 Q1 Mf Mm Ssa
Amplitude (μ Gal): 1.648 0.577 0.908 0.723 0.294 0.272 0.161 0.171 0.000 0.000 0.000
Phase (deg): 15.1 -26.5 30.5 33.4 38.7 26.2 -22.2 40.8 0.0 0.0 0.0

Instrument Data

Meter Type: FG5
Meter S/N: 216
Factory Height: 125.83 cm
Rubidium Frequency: 10000000.00000 Hz
Laser: WEO100 (242)
ID: 632.99117754 nm (0.90 V)
IE: 632.99119473 nm (0.55 V)
IF: 632.99121259 nm (0.15 V)
IG: 632.99123023 nm (-1.19 V)
IH: 632.99136890 nm (-1.61 V)
II: 632.99139822 nm (-1.32 V)
IJ: 632.99142704 nm (-1.05 V)
Modulation Frequency: 8333.340 Hz

Processing Results

Date: 11/11/16
Time: 05:25:44
DOY: 316
Year: 2016
Time Offset (D h:m:s): 0 0:0:0
Gravity: 978574601.13 μ Gal

Set Scatter: 0.84 μGal
Measurement Precision: 0.20 μGal
Total Uncertainty: 0.20 μGal
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: 200
Total Drops Accepted: 3381
Total Drops Rejected: 19
Total Fringes Acquired: 1100
Fringe Start: 2
Processed Fringes: 1030
GuideCard Multiplex: 4
GuideCard Scale Factor: 250

Acquisition Settings

Set Interval: 60 min
Drop Interval: 5 sec
Number of Sets: 24
Number of Drops: 200

Gravity Corrections

Earth Tide (ETGTAB): 34.62 μGal
Ocean Load: 0.14 μGal
Polar Motion: -3.58 μGal
Barometric Pressure: -0.09 μGal
Transfer Height: 413.19 μGal
Reference Xo: 0.00 μGal

Set File

Source Data Filename: FB20161110

g Acquisition Version: 9.110914

g Processing Version: 9.120423

Set	Time	DOY	Year	Gravity	Sigma	Error	Uncert	Tide	Load	Baro	Polar	Transfer	Refxo	Tilt	Diffraction	SelfAttract	Temp	Pres	Chan5	Chan6	Chan7	Chan8	Chan9	Chan10	Accept	Reject
1	21:25:40315	2016	978574602.755	9.115	0.648	0.648	-56.623	-0.531	-0.262	-3.580	413.190	0.004	0.000	0.000	0.000	40.961	970.798	-0.000	445.657	358.566	0.000	0.000	0.000	198	2	
2	22:25:45315	2016	978574601.082	8.059	0.571	0.571	-11.906	0.214	-0.162	-3.580	413.190	0.004	0.000	0.000	0.000	40.905	971.130	-0.000	324.799	236.653	0.000	0.000	0.000	199	1	
3	23:25:38315	2016	978574600.483	8.788	0.626	0.626	43.904	0.912	0.007	-3.580	413.190	0.004	0.000	0.000	0.000	40.464	971.692	-0.000	381.142	286.533	0.000	0.000	0.000	197	3	
4	00:25:42316	2016	978574601.955	7.295	0.518	0.518	97.323	1.402	0.166	-3.580	413.190	0.004	0.000	0.000	0.000	39.822	972.222	-0.000	403.859	298.854	0.000	0.000	0.000	198	2	
5	01:25:44316	2016	978574601.946	7.552	0.534	0.534	134.735	1.565	0.255	-3.580	413.190	0.003	0.000	0.000	0.000	39.146	972.520	-0.000	400.175	285.405	0.000	0.000	0.000	200	0	
6	02:25:44316	2016	978574602.163	7.507	0.531	0.531	146.774	1.362	0.245	-3.580	413.190	0.004	0.000	0.000	0.000	38.939	972.487	-0.000	441.840	319.190	0.000	0.000	0.000	200	0	
7	03:25:45316	2016	978574599.688	7.176	0.510	0.510	130.647	0.841	0.113	-3.580	413.190	0.003	0.000	0.000	0.000	38.867	972.048	0.000	449.687	327.667	0.000	0.000	0.000	198	2	
8	04:25:44316	2016	978574600.560	7.096	0.502	0.502	90.799	0.126	0.017	-3.580	413.190	0.003	0.000	0.000	0.000	38.661	971.725	0.000	449.585	325.960	0.000	0.000	0.000	200	0	
9	05:25:45316	2016	978574599.995	7.573	0.537	0.537	37.653	-0.611	-0.126	-3.580	413.190	0.004	0.000	0.000	0.000	38.395	971.251	0.000	440.462	307.834	0.000	0.000	0.000	199	1	
10	06:25:44316	2016	978574600.533	7.443	0.526	0.526	-15.192	-1.192	-0.289	-3.580	413.190	0.003	0.000	0.000	0.000	38.320	970.706	0.000	456.220	327.025	0.000	0.000	0.000	200	0	
11	07:25:44316	2016	978574600.869	7.840	0.554	0.554	-54.537	-1.478	-0.415	-3.580	413.190	0.004	0.000	0.000	0.000	38.146	970.288	0.001	502.265	380.665	0.000	0.000	0.000	200	0	
12	08:25:46316	2016	978574600.949	6.982	0.495	0.495	-70.866	-1.404	-0.420	-3.580	413.190	0.003	0.000	0.000	0.000	38.053	970.271	0.001	532.819	408.854	0.000	0.000	0.000	199	1	
13	09:25:44316	2016	978574601.362	7.177	0.507	0.507	-60.613	-0.992	-0.351	-3.580	413.190	0.003	0.000	0.000	0.000	37.780	970.501	0.001	586.745	466.745	0.000	0.000	0.000	200	0	
14	10:25:44316	2016	978574601.747	7.626	0.539	0.539	-26.908	-0.351	-0.259	-3.580	413.190	0.003	0.000	0.000	0.000	37.567	970.806	0.001	612.725	497.380	0.000	0.000	0.000	200	0	
15	11:25:54316	2016	978574602.513	7.856	0.557	0.557	21.432	0.354	-0.088	-3.580	413.190	0.003	0.000	0.000	0.000	37.592	971.378	0.001	668.563	568.849	0.000	0.000	0.000	199	1	
16	12:25:40316	2016	978574600.714	7.535	0.537	0.537	71.407	0.935	0.012	-3.580	413.190	0.003	0.000	0.000	0.000	39.933	971.711	-0.000	545.538	413.122	0.000	0.000	0.000	197	3	
17	13:25:46316	2016	978574600.517	7.505	0.535	0.535	110.493	1.245	0.107	-3.580	413.190	0.003	0.000	0.000	0.000	43.400	972.025	-0.002	235.614	137.107	0.000	0.000	0.000	197	3	

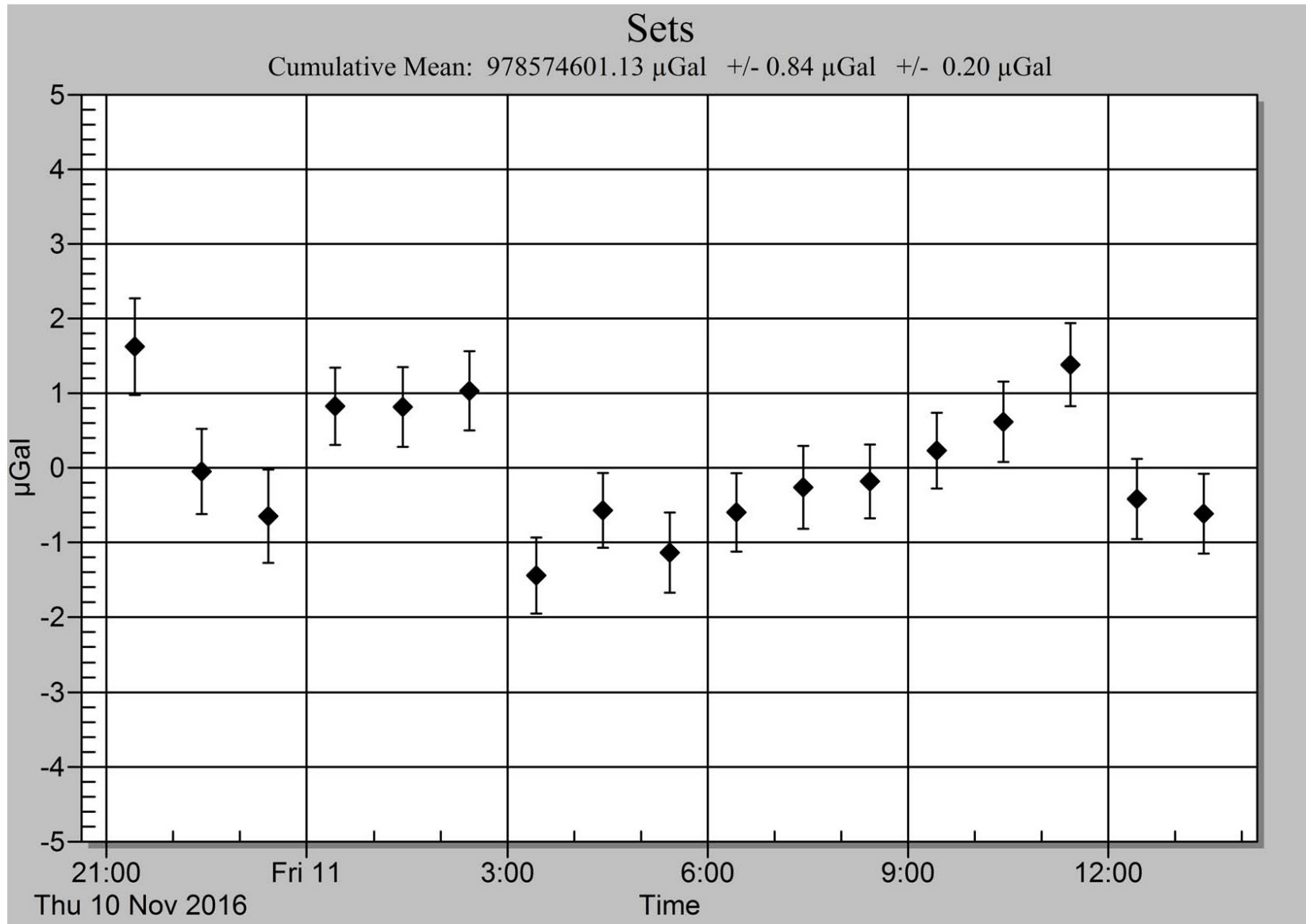


Figure 2. Plot of the set gravity values (1 set = 200 drops).

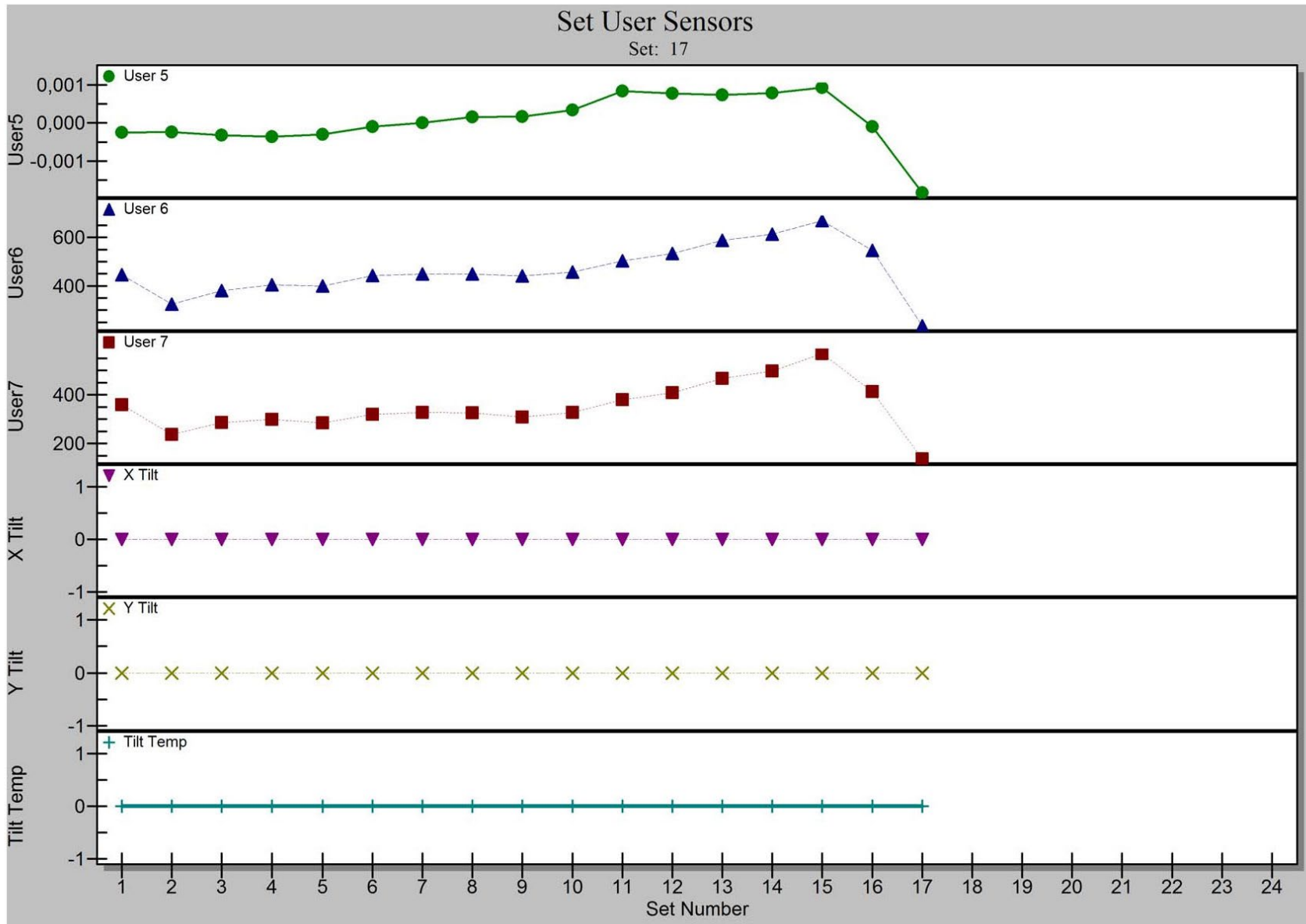


Figure 3. Plot of the set sensor data (1 set = 200 drops).

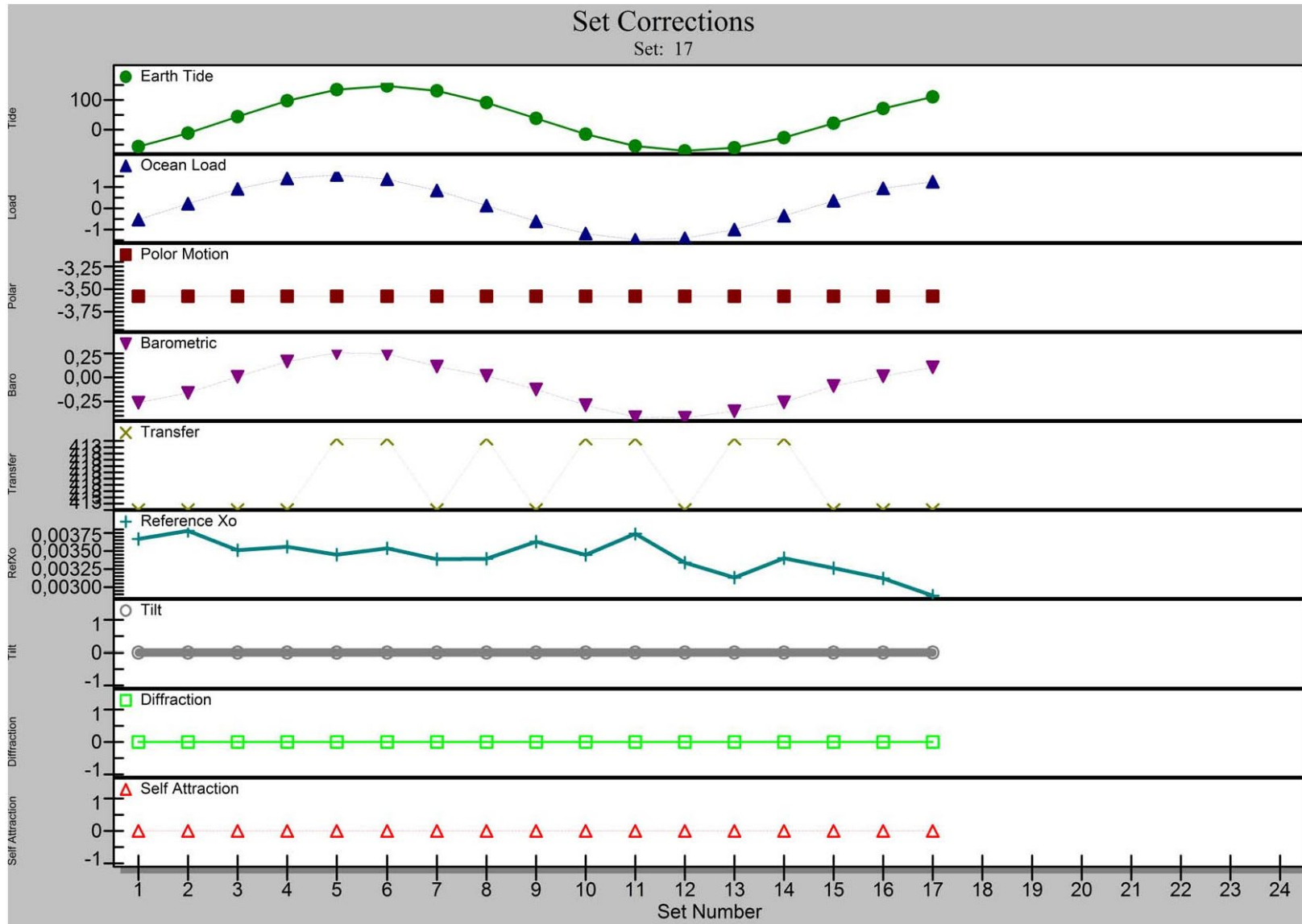


Figure 4. Plot of the set corrections values (1 set = 200 drops).