



中国科学院测量与地球物理研究所

Institute of Geodesy and Geophysics, Chinese Academy of Sciences

Station report of superconducting gravimeters in Chinese mainland

Sun Heping Hsu Houze Xu Jianqiao Zhou Jiangcun

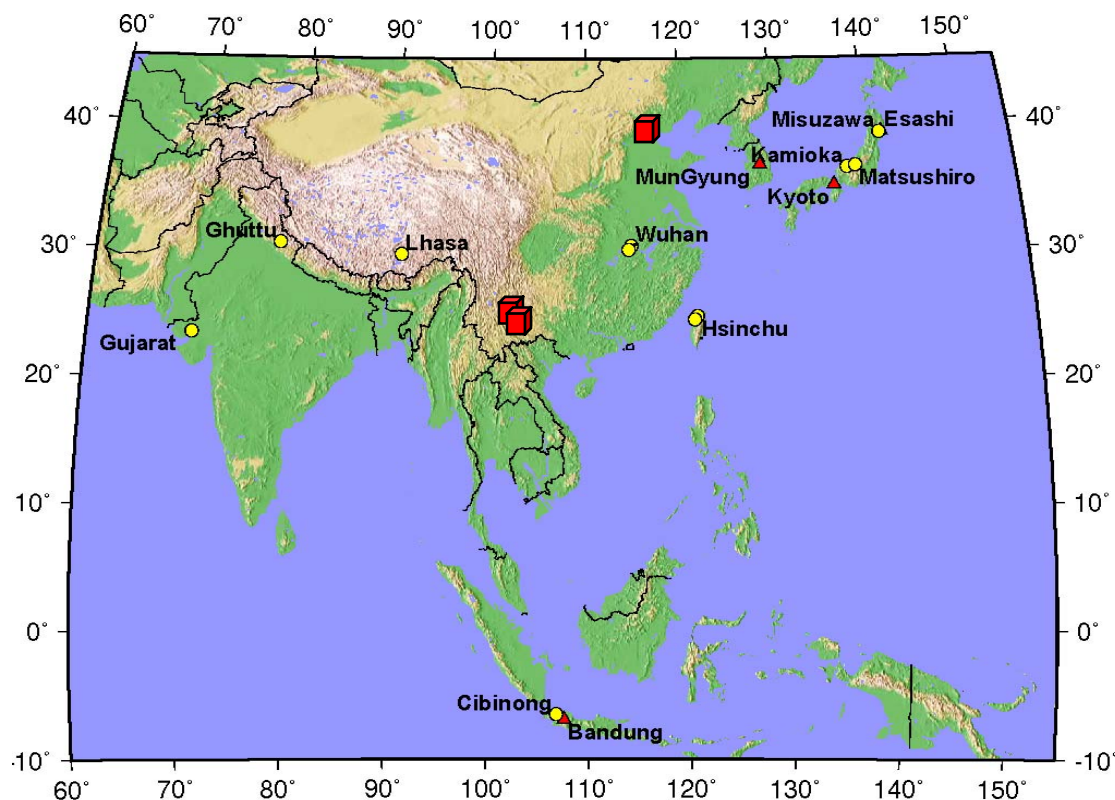
Chen Xiaodong Cui Xiaoming

June 18-20, 2018 Potsdam

SG Present Situation in China

Current: 8 SGs

GGP : 3 stations



●CAS: OSG065~2013~Wuhan

●CAS : OSG057~2009~Lhasa

●CAS : OSG066~2013~Lijiang

◆CEA: OSG053~2008~ Wuhan

◆CEA: iGrav ~2017~ Yichang

■WHU:iGrav-007, Kunming

■NIM: iGrav-012~2014~Beijing

■HUST: ----

Station Introduction

Wuhan (CAS) -JiuFeng



C032->OSG065
30° 31'N 114° 29'E
1997~2013,3~



Wuhan (CEA)



OSG053
30° 31'N 114° 29'E
2008,9-



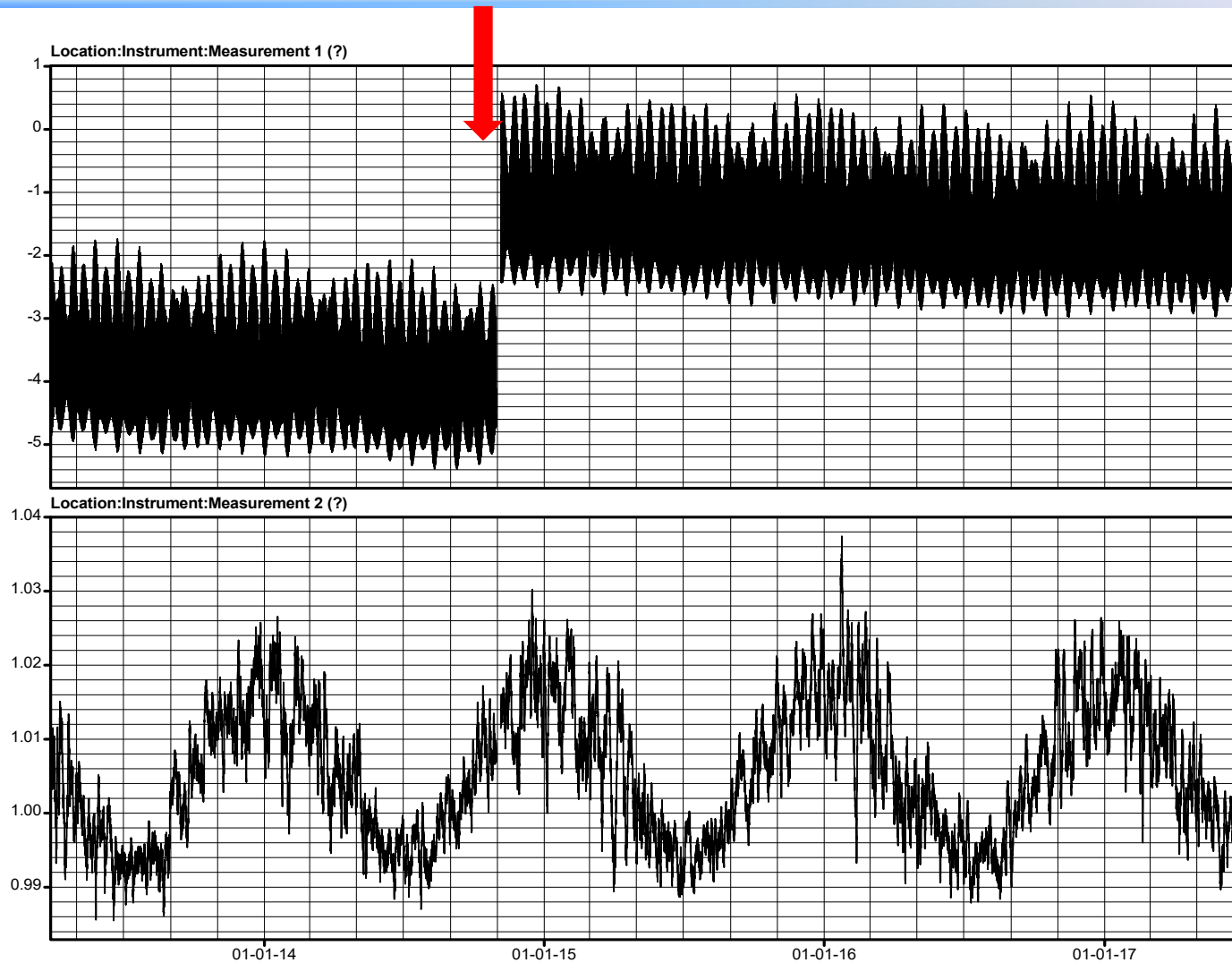
Kunming (WHU)



iGrav-007

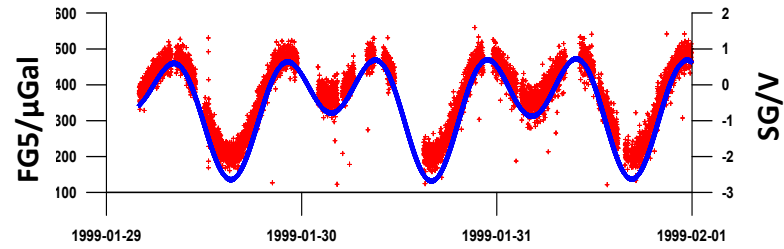


Wuhan (CAS) -JiuFeng



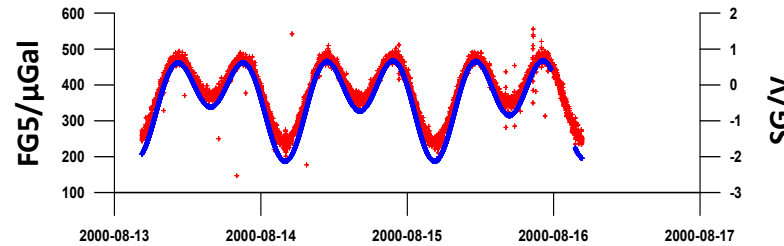
1、1999~C032

Calibration factor:
 -84.0190 ± 0.2070 ,
relative accuracy: 0.25%。



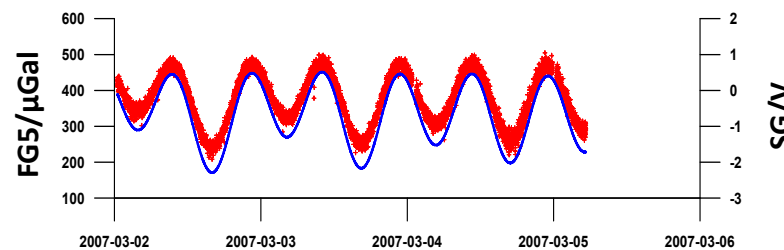
2、2000~C032

Calibration factor:
 -84.6678 ± 0.1759 ,
relative accuracy 0.21%。



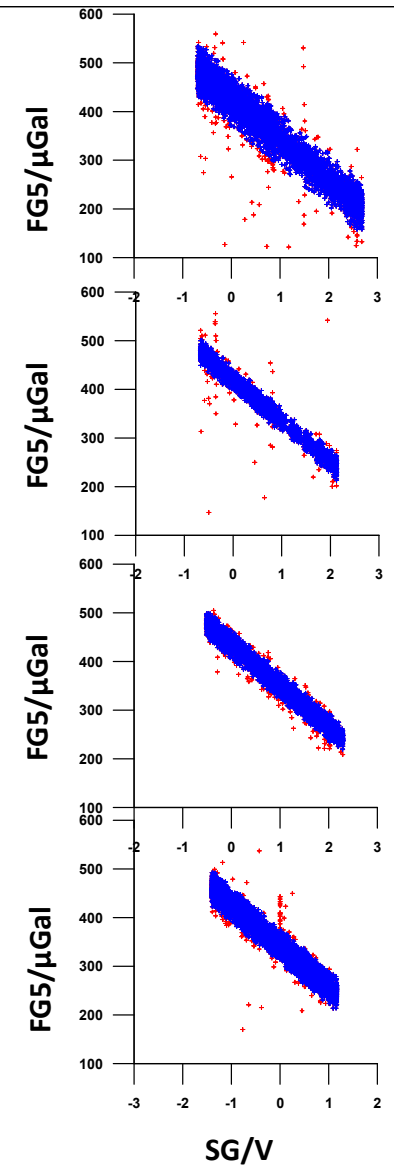
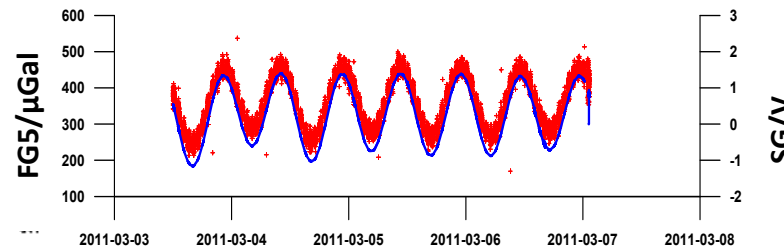
3、2007~C032

Calibration factor:
 -84.1174 ± 0.1420 ,
relative accuracy 0.17%。



4、2011~C032

Calibration factor:
 -84.5574 ± 0.1584 ,
relative accuracy: 0.19%。

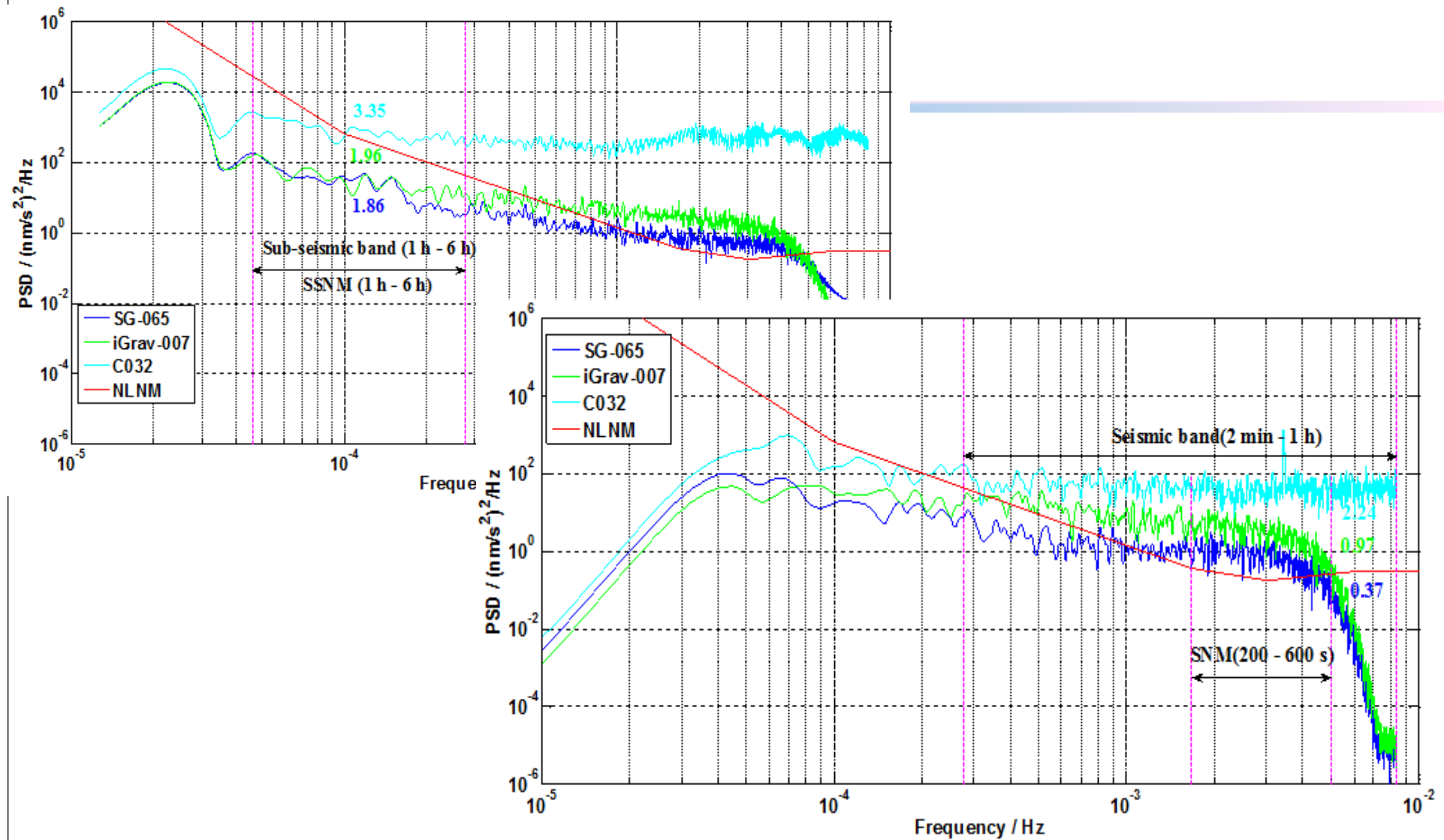


5、2013~OSG065

-----Calibration Information-----

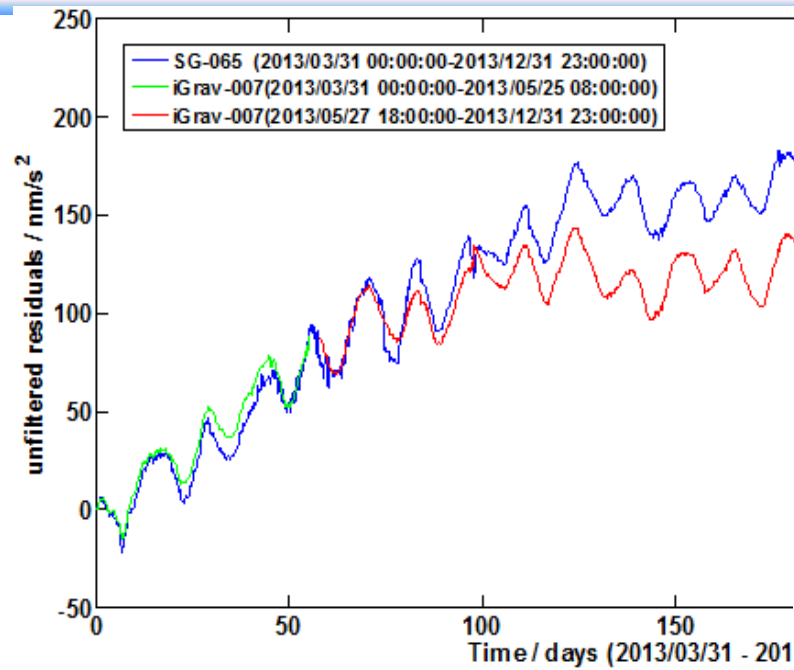
Gravity Cal(ugal/v): -92.3927 0.0373

Relative accuracy: 0.04%



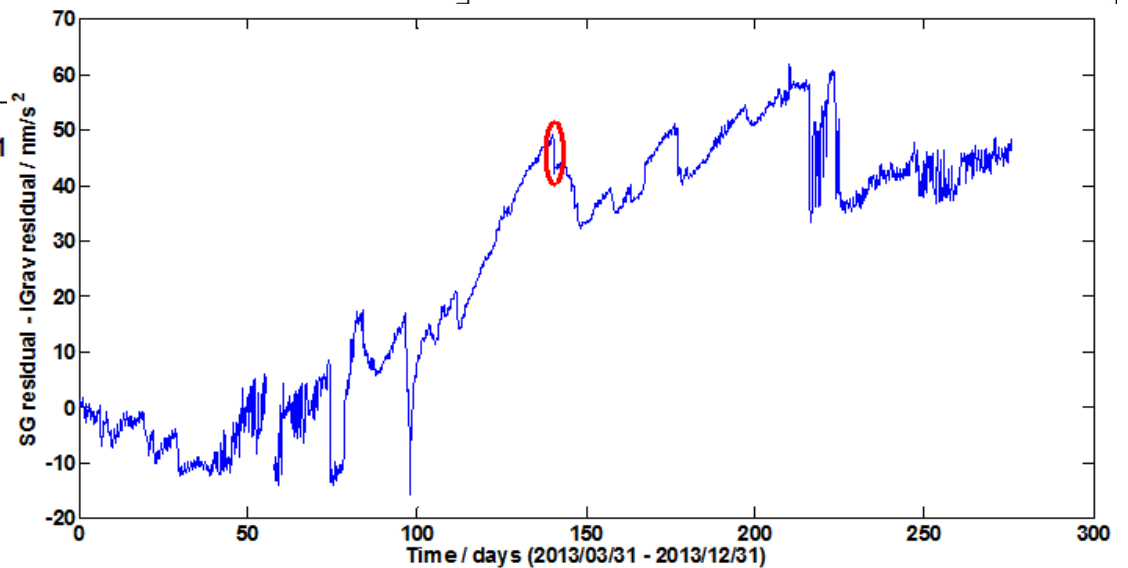
The power spectral density of iGrav-007, OSG-065 and C032 in Wuhan Station
SSNM---15 quietest days (up); SNM---5 quietest days(lo)

Zhang MM, 2016



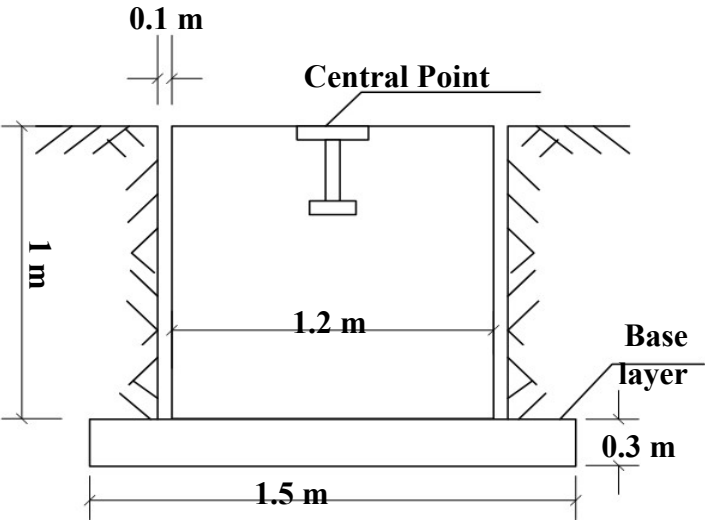
the gravity residuals of the two SGs
obtained at same time period

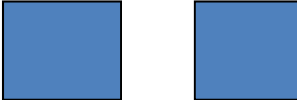
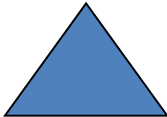
Zhang MM, 2016



the difference between the two gravity residuals
(OSG-065-iGrav-007)

Lhasa Station, Tibet

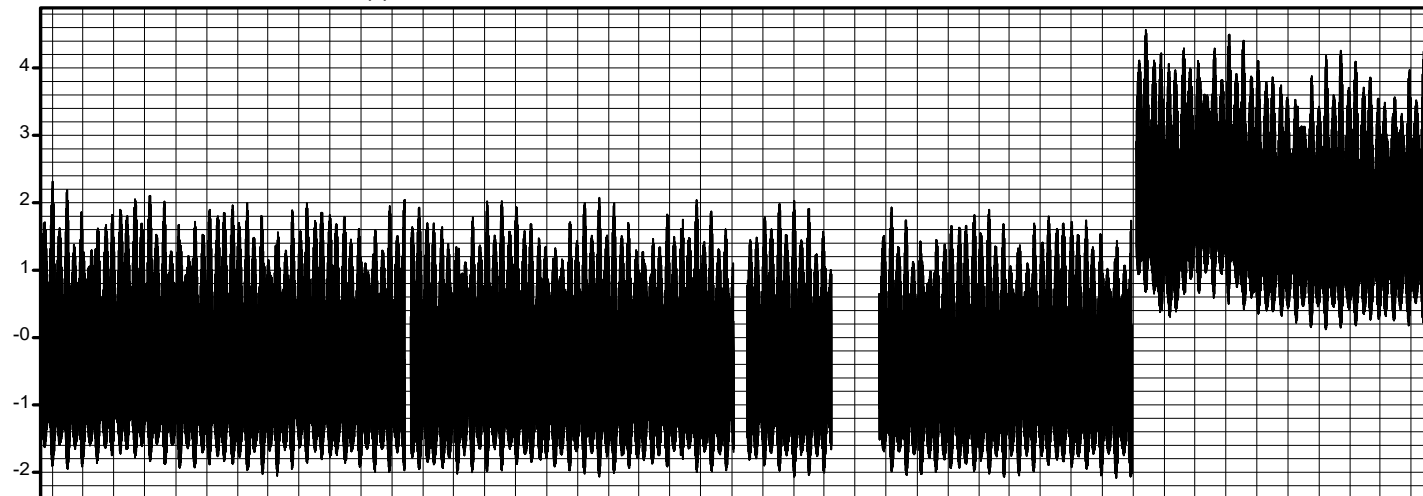


Hall	Computer Room
LCR-ET20  Measurement Piers	SG 057  SG
	sensor

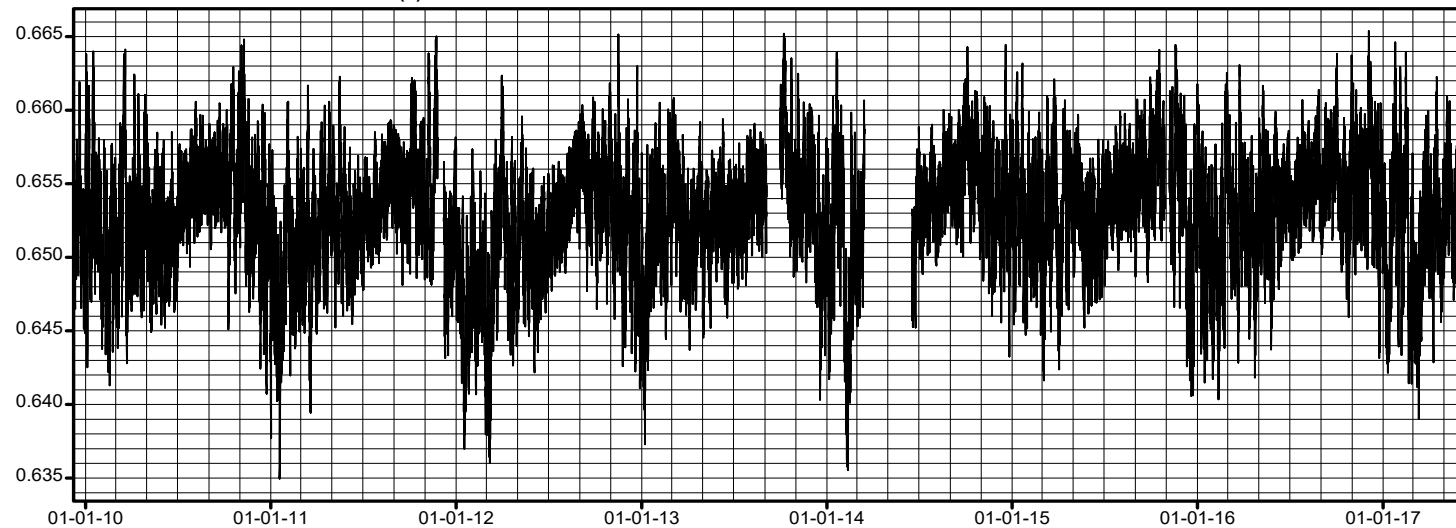


OSG057
2009

Location:Instrument:Measurement 1 (?)



Location:Instrument:Measurement 2 (?)



LCR-ET20

Apriori scale value: $C_P = -79.5$ microgals / V

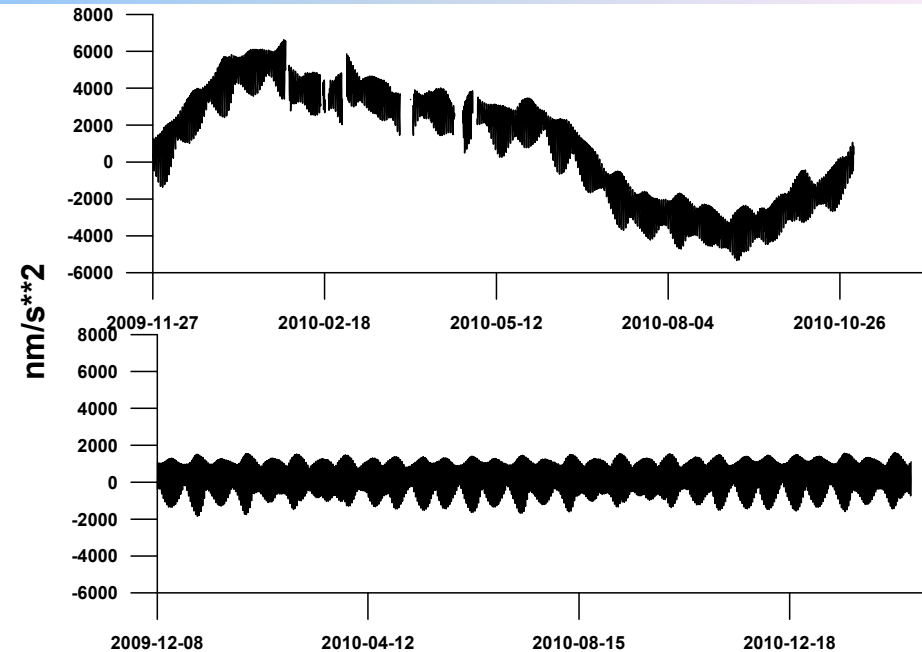
Weighted ratio factor and its accuracy: $S^w = 0.975578 \pm 0.000513$

New scale value:
$$\begin{cases} C = S \cdot C_P \\ \Delta C = \Delta S \cdot C_P \end{cases}$$

$C = -77.7358$ microgals / V

Accuracy: $\Delta C = 0.0409$ microgals / V

Relative accuracy: 0.05%



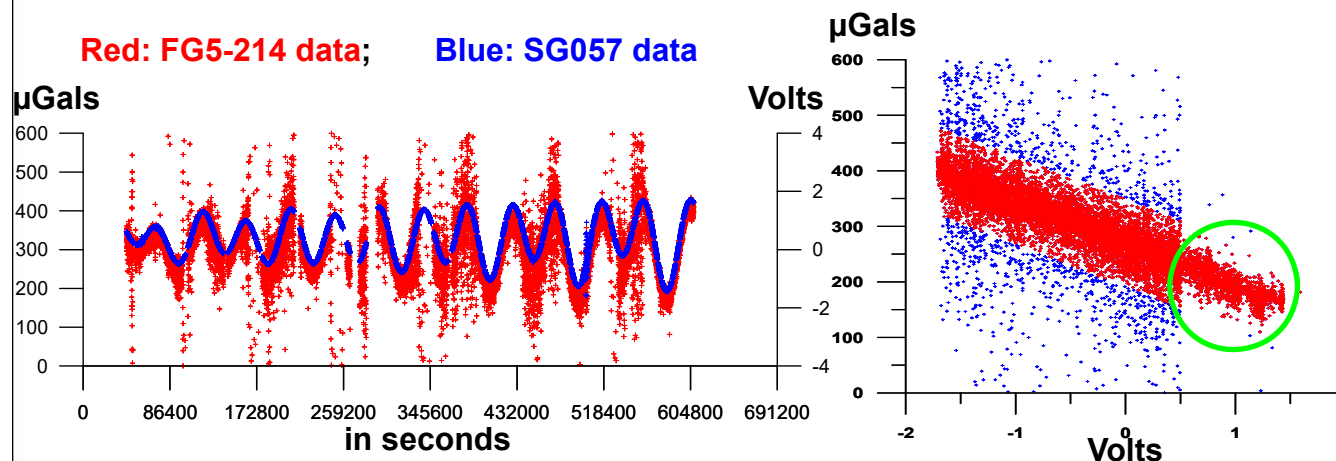
FG5-214

October 16 ~ 23, 2010

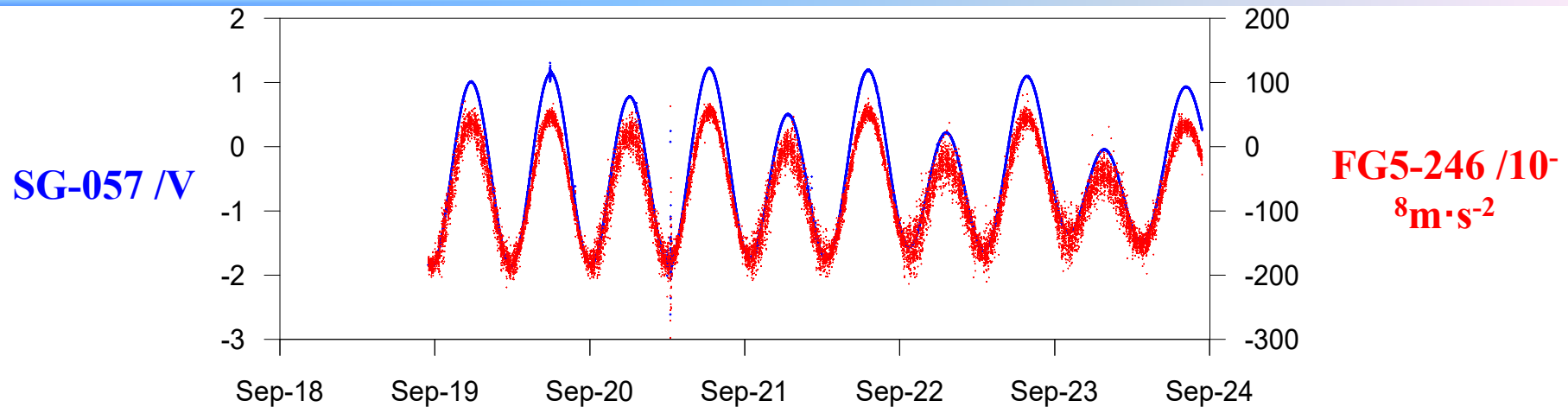
Method: iterative linear regression

Limiting value: triplex of standard deviation of the residuals

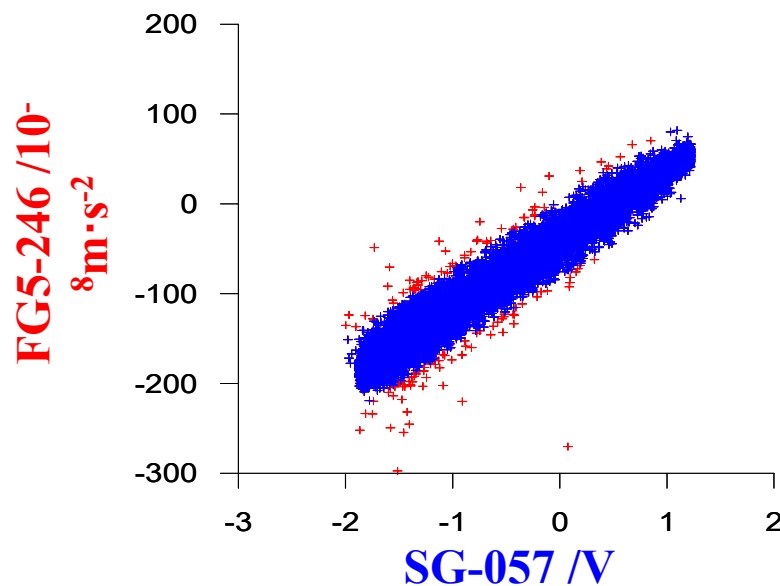
Results:
Calibration factor:
 -76.4897 ± 0.3047
Relative accuracy: 0.40%



FG5-246 2013/9/18~22:



SG-057(blue) and FG5-246(red) observations



Method: iterative linear regression

Limiting value: triplex of standard deviation of the residuals

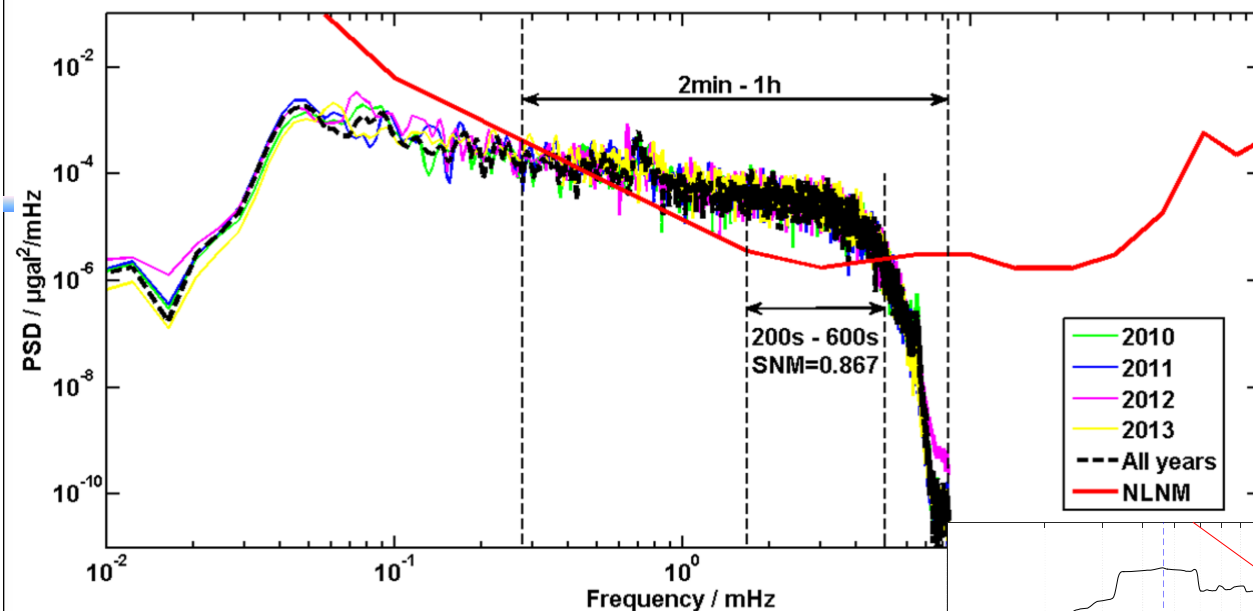
Results:

Calibration factor:

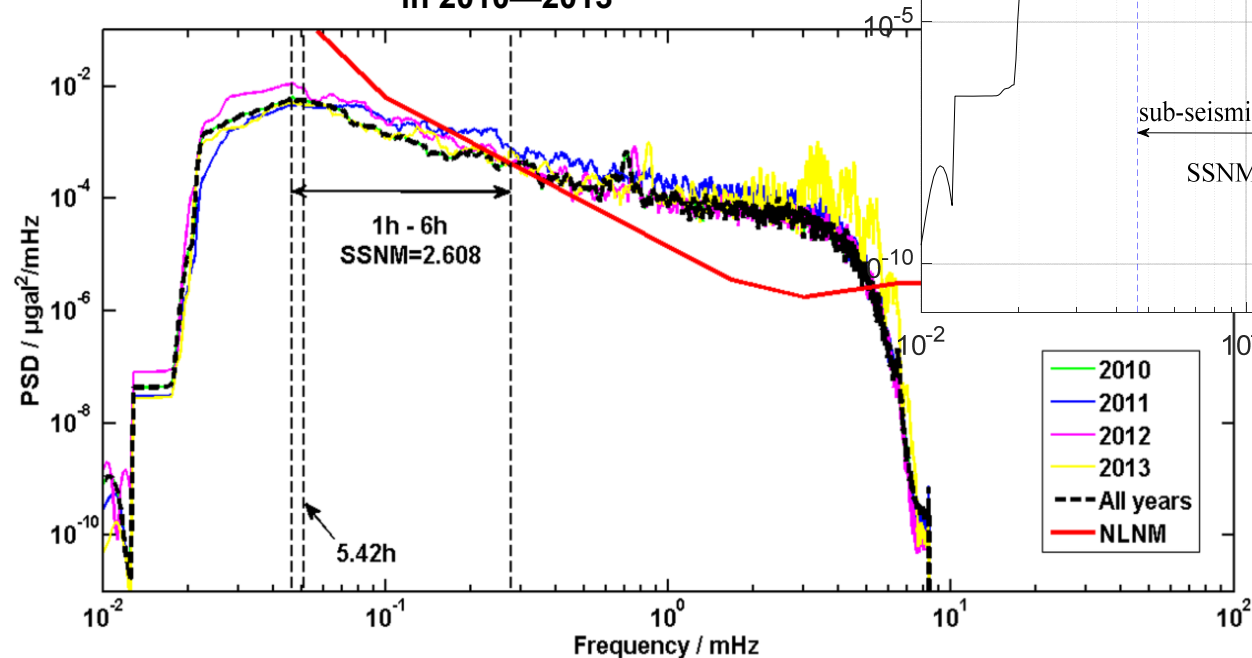
-77.1290 ± 0.0462

Relative accuracy: 0.06%

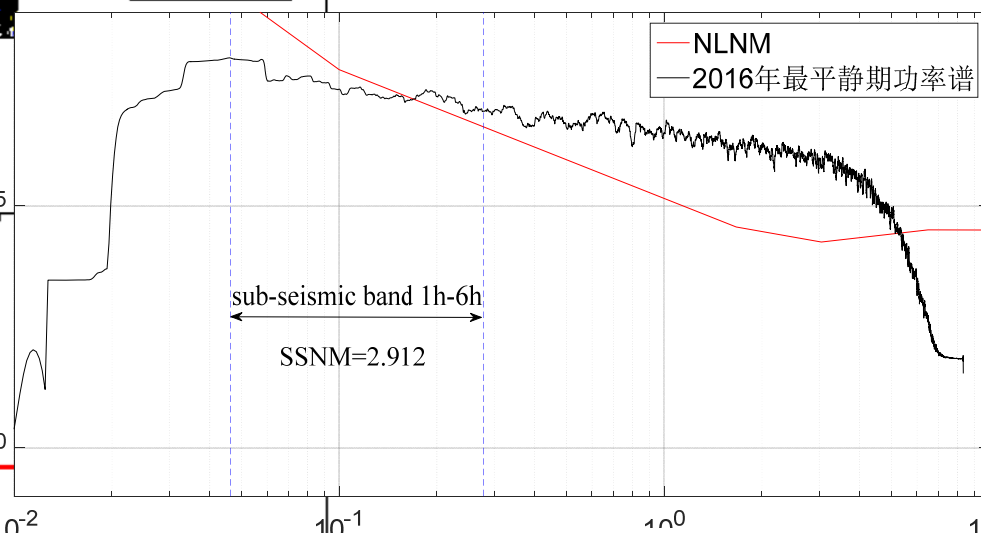
Zhang MM, 2016
Liu ZW, 2018



Lhasa: The power spectral density of 5 quietest days in 2010—2013



Lhasa: The power spectral density of 15 quietest days in 2010—2013



Lhasa: The power spectral density of 15 quietest days in 2016

Lhasa: The averaged noise levels in tidal band

Frequency (cycles/day)	OSG-057 noise level (nm s ⁻²)
0.1	0.249024
1	0.043853
2	0.048901
3	0.007124
4	0.004610

Lhasa: harmonic analysis (2010-2015)

wave	This study (δ & RMS)	Xu (2012) (δ)	DDW99(δ)
O ₁	1.16303(± 0.00013)	1.16601	1.1556
K ₁	1.13742(± 0.00010)	1.14728	1.1346
M ₂	1.16515(± 0.00007)	1.17158	1.1594
S ₂	1.15923(± 0.00015)	1.17016	1.1594

1.036291 1.044801
1.064840 1.071084
1.072582 1.080945
1.099160 1.216398
1.719380 1.837970
1.853919 1.862429

Lhasa: harmonic analysis (2010-2015)

波群	理论振幅 (0.1 μ Gal)	振幅因子及其标准差	相位滞后及其标准差 ($^{\circ}$)
SGQ1	1.9712	1.16400 0.00608	0.3092 0.2992
2Q1	6.7658	1.17387 0.00207	0.8648 0.1011
SGM1	8.1590	1.17353 0.00171	0.4254 0.0835
Q1	51.1282	1.17454 0.00029	0.2188 0.0140
RO1	9.7047	1.17391 0.00152	0.1881 0.0743
	267.0365	1.17017 0.00006	0.0038 0.0028
TAU1	3.4808	1.15525 0.00355	0.3024 0.1762
NO1	20.9907	1.16477 0.00065	-0.0443 0.0321
CHI1	4.0166	1.16135 0.00392	-0.1550 0.1936
P1	124.2314	1.15823 0.00012	-0.0099 0.0059
S1	2.9359	1.53603 0.01249	15.9522 0.4800
K1	375.4071	1.14427 0.00004	0.0593 0.0021
TET1	4.0155	1.16365 0.00384	0.2224 0.1891
J1	20.9982	1.16565 0.00074	0.0620 0.0364
SO1	3.4824	1.17419 0.00443	-0.2914 0.2161
OO1	11.4845	1.16547 0.00137	0.0039 0.0675
NU1	2.1993	1.15973 0.00654	-0.0441 0.3232
EPS2	4.1934	1.18222 0.00235	-0.2986 0.1137
2N2	14.3795	1.17946 0.00080	-0.7026 0.0391

Zhang MM, 2016

He QQ, 2017

Lijiang, Yunnan



OSG066

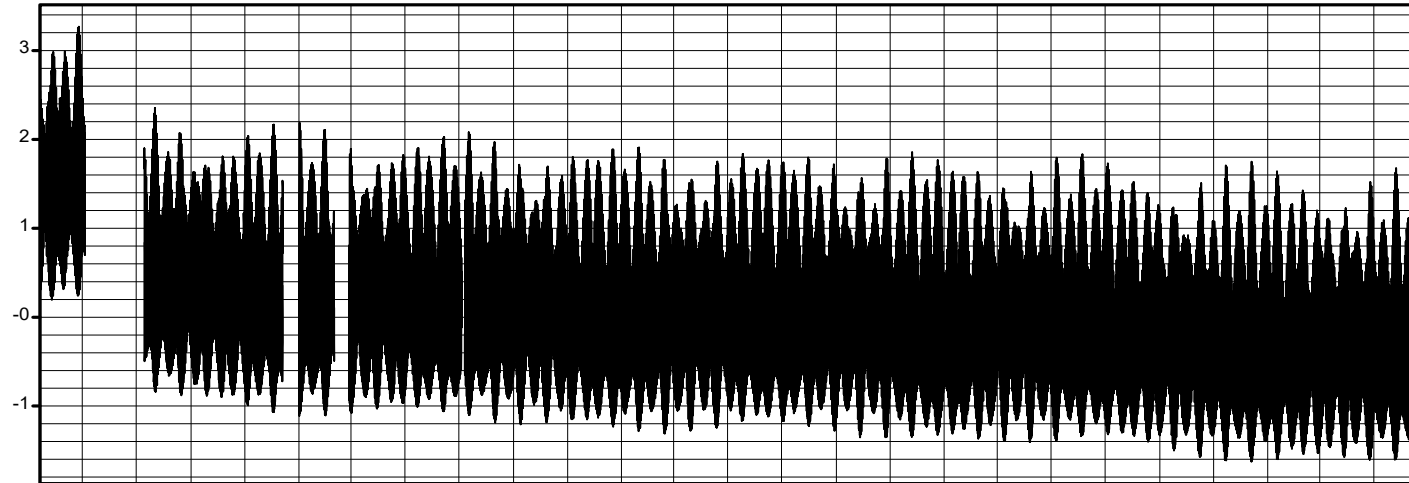
26° 54'N 100° 14'E

2013,3-

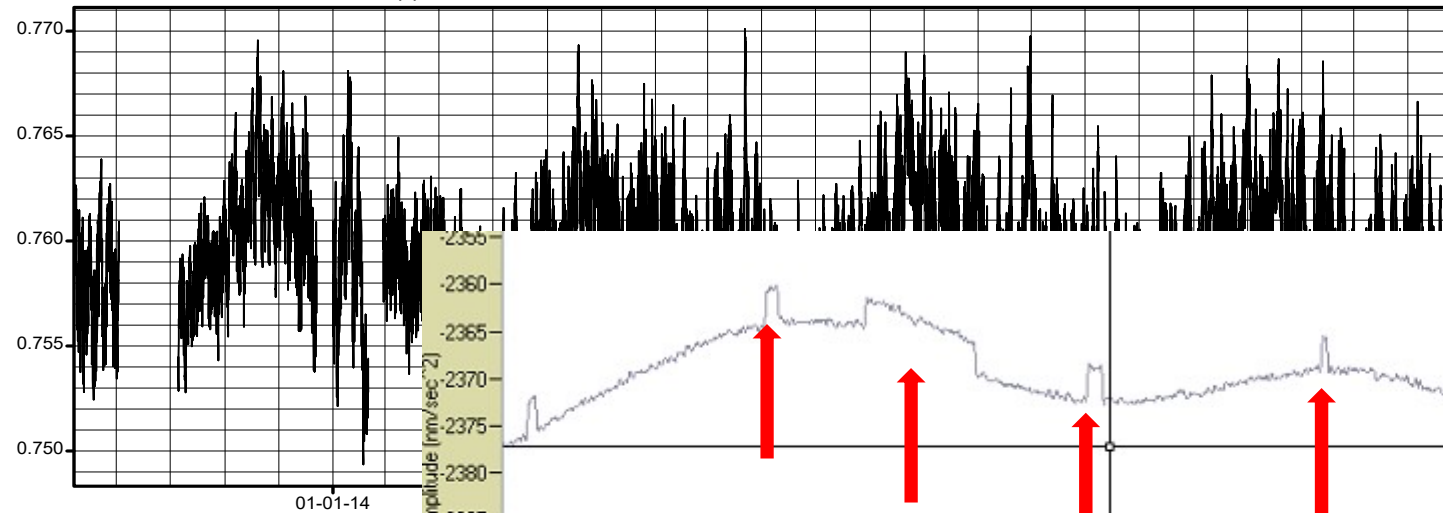
N. Latitude (deg) : 26.8956
E. Longitude (deg) : 100.2323
Elevation MSL (m) : 2435.00



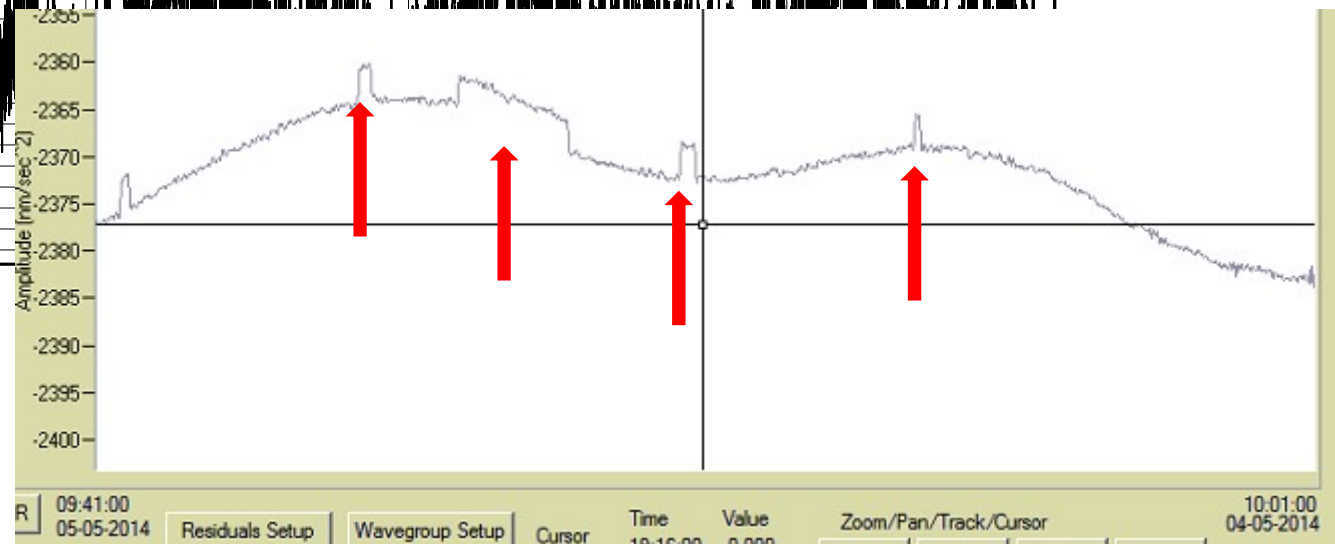
Location:Instrument:Measurement 1 (?)



Location:Instrument:Measurement 2 (?)



01-01-14



The Calculation of OSG-066 at Lijiang

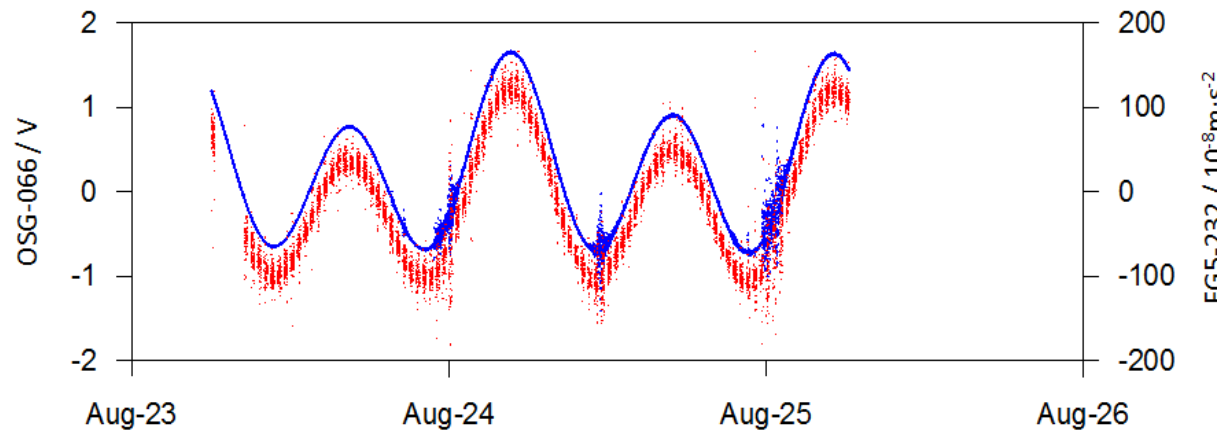


Fig.1 Recordings of FG5-232 (red) and OSG-066

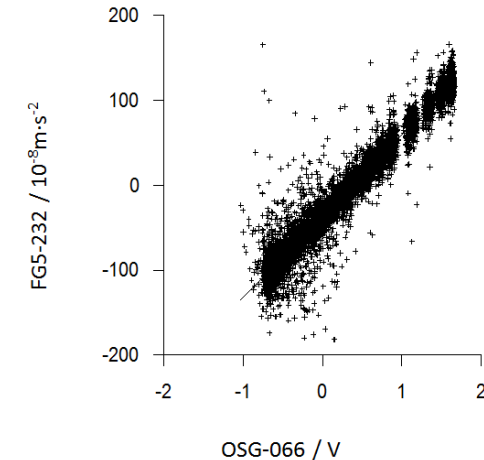


Fig.2 Linearity of the recordings of FG5-232 and OSG-066

- ❑ A New and Practical Weighted Method for the Estimation of Parameters for a Linear Regression Model;
- ❑ Proposed by Dr. Xiaodong Chen (Email: chenxd@whigg.ac.cn)

Gravity Cal($\mu\text{gal}/\text{V}$) : **-96.3319 ± 0.0611**

Relative accuracy : **0.06 %**

Tidal parameters of Wuhan\Lhasa\Lijiang

	Wuhan	Lhasa	Lijiang
O1	1.17569 (0.00039)	1.16115 (0.00013)	1.16606 (0.00020)
K1	1.14890 (0.00026)	1.13524 (0.00014)	1.13967 (0.00014)
M2	1.17152 (0.00006)	1.16294 (0.00003)	1.16622 (0.00004)
S2	1.16551 (0.00017)	1.15680 (0.00009)	1.15974 (0.00010)

Liu ZW, 2018

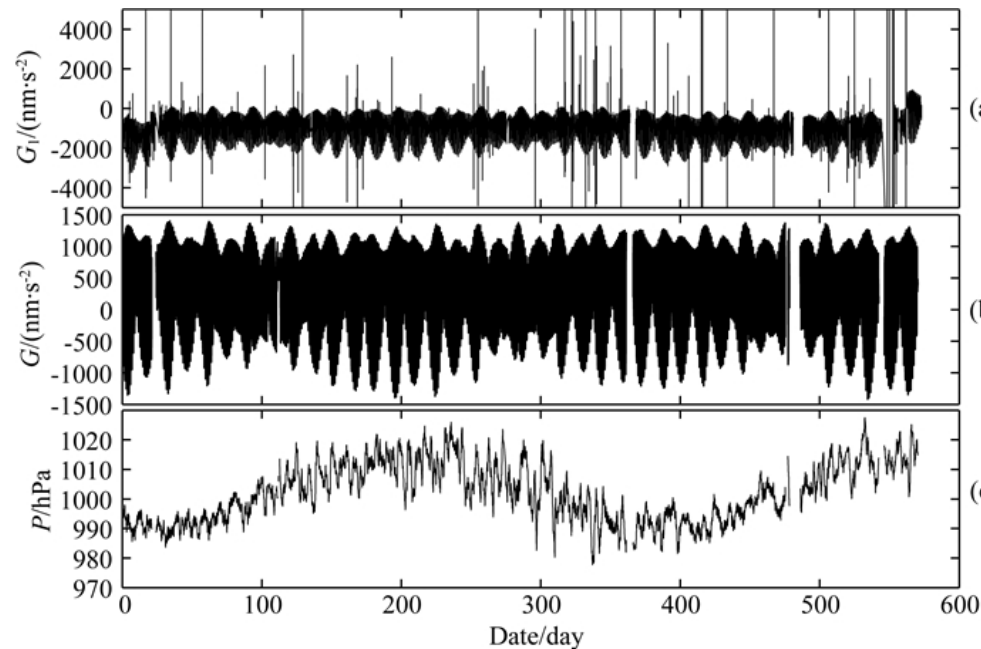
Beijing (NIM)



40.245.N, 116.225.E, 121.106 m
iGrav-012

National Institute of Metrology,
China;





The observation data registered with superconducting gravimeter (a) Original tidal gravity observations; (b) Corrected tidal gravity data; (c) Atmospheric pressure at the station.

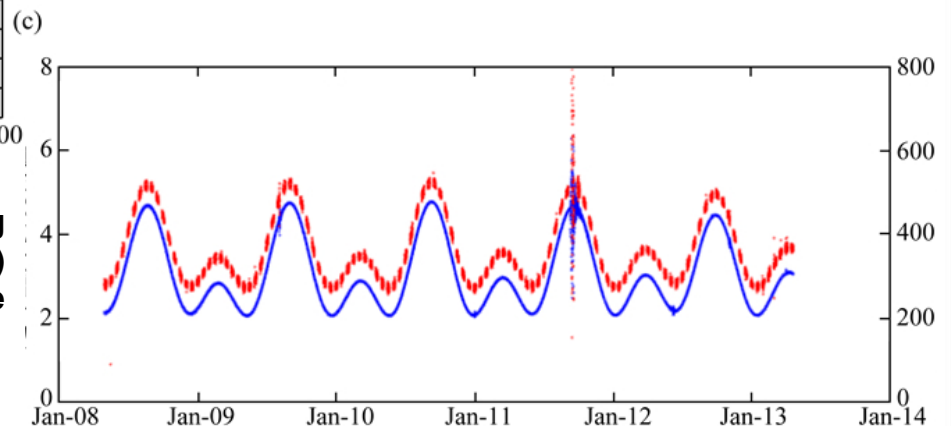
Sun HP et al, 2017

2014:

Calibration factor: -92.5442 ± 0.1362
Relative accuracy : 0.15 %

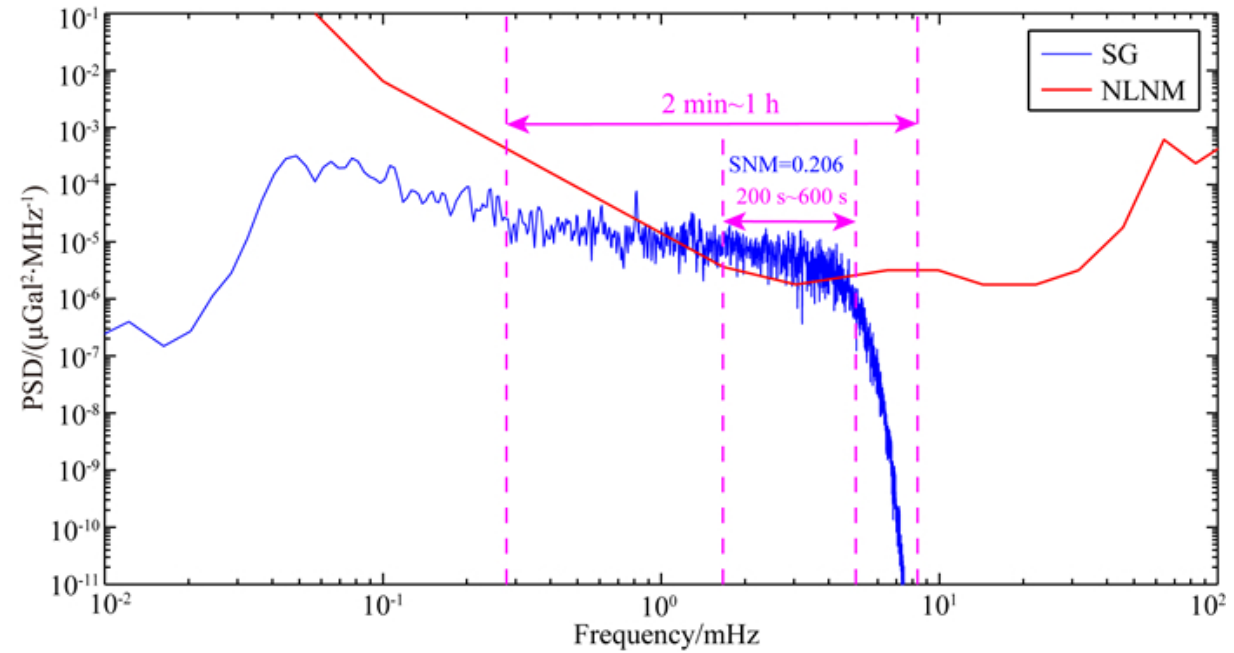
2016:

Calibration factor: -92.8344 ± 0.0237
Relative accuracy : 0.03 %



Co-located measurements recorded with FG5 (red) and SG (blue)

The power spectral density of 5 quietest days in 2014—2015



The averaged noise levels in tidal band

Frequency/cpd	Noise levels/(nm·s ⁻²)
1	0.04097
2	0.03256
3	0.03288
4	0.01944

Sun HP et al, 2017

Data Situation

(1) data: uploaded on time (1min, cor-1min, cor-1h);

- **CAS: C032/OSG065~Wuhan~2017.6**

- **CAS : OSG057~Lhasa~2017.6**

- **CAS : OSG066~Lijiang~2017.6**

(2) 1s data: too large!

- **unstable transmission and slow uploading speed.**

- **copy the 1s data 3 CAS stations to IGETS data center.**

Thank you for your attention !