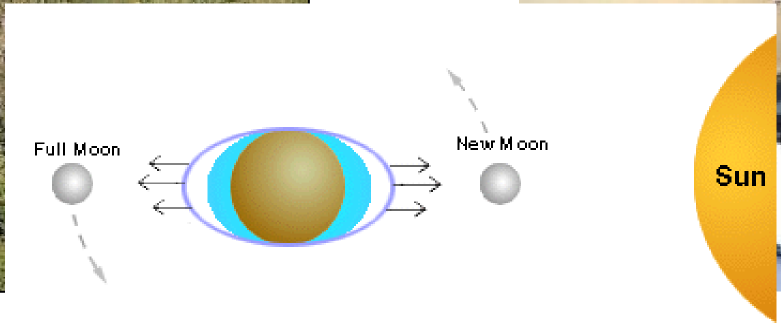
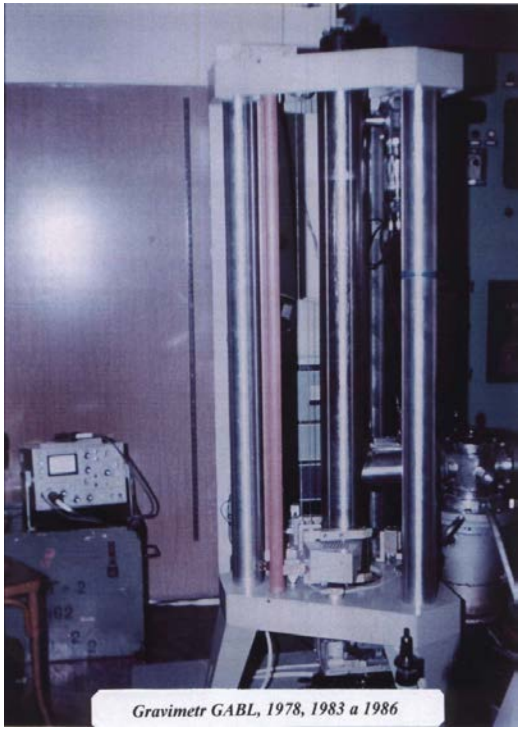
Gravimetry at the station Pecný

Vojtech Pálinkáš

Research Institute of Geodesy, Topography and Cartography,
Czech Republic

History

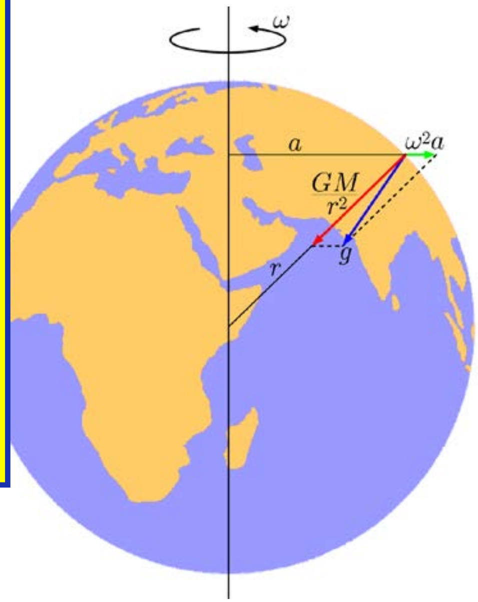




1970's

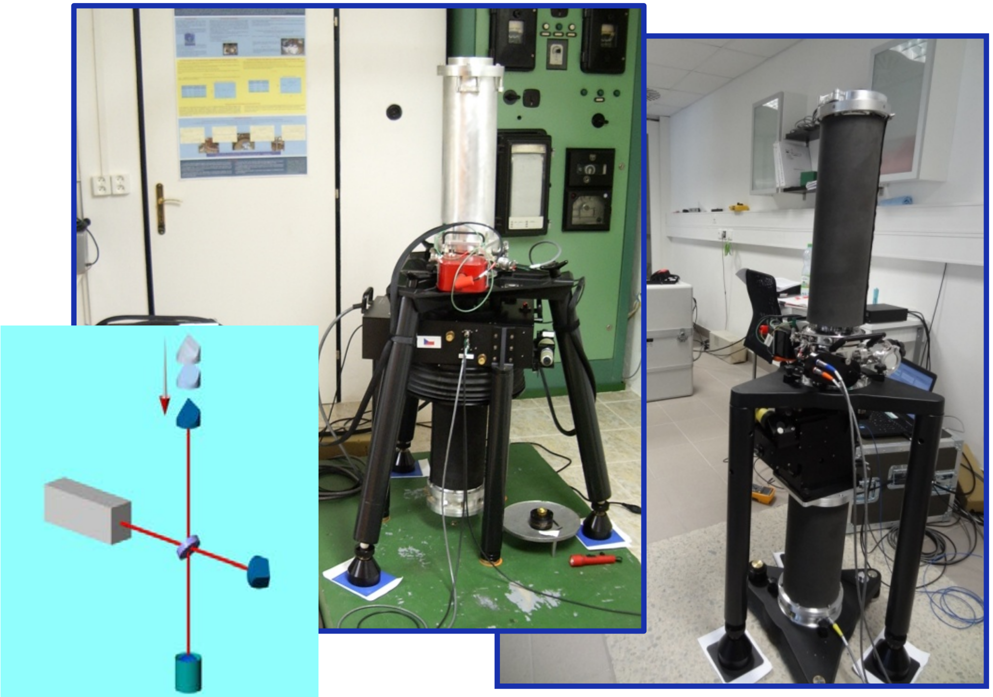
Measurement and analysis of vertical component of tidal acceleration (gravity variations)

First site with absolute gravity measurement in the Czech Republic



Current state at Pecný

ABSOLUTE GRAVIMETRY



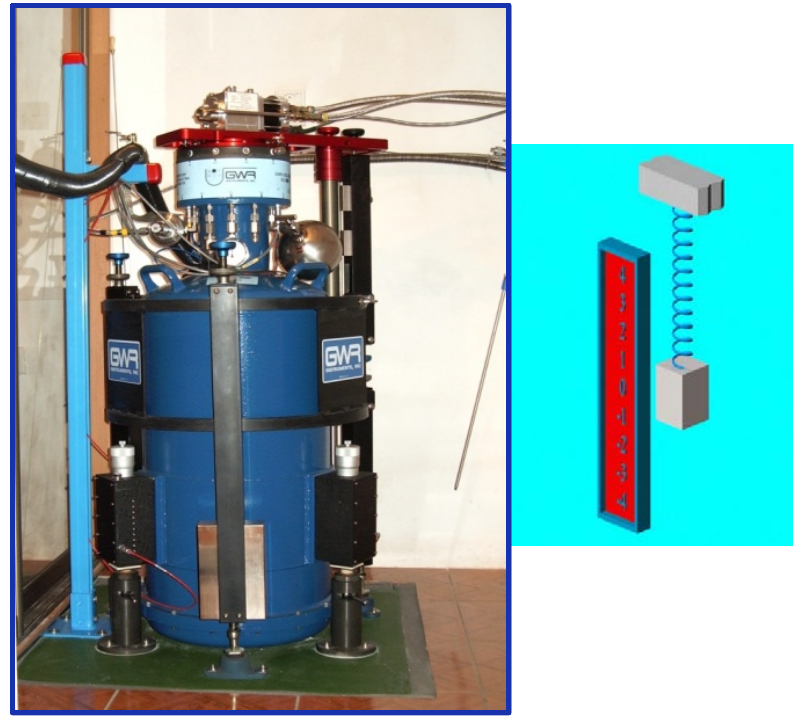
Absolute gravimeters FG5-215 and FG5X-251

(transportable, meaasurement once per month)

Applications:

- gravimetric networks
- geodynamics of regional and global origin
- metrology (watt balance, calibration of relative gravimeters)

RELATIVE GRAVIMETRY



Superconducting gravimeter OSG-050

(continual observation, 1 sec sampling rate)

Applications:

- Earth tides, seismology, geodynamics
- determination of the reference gravity function

Combination of AG and SG

Superconducting Gravimeter (SG)

- relative values
- precision < 0.1 nm/s^2
- continuous registration
- high temporal resolution

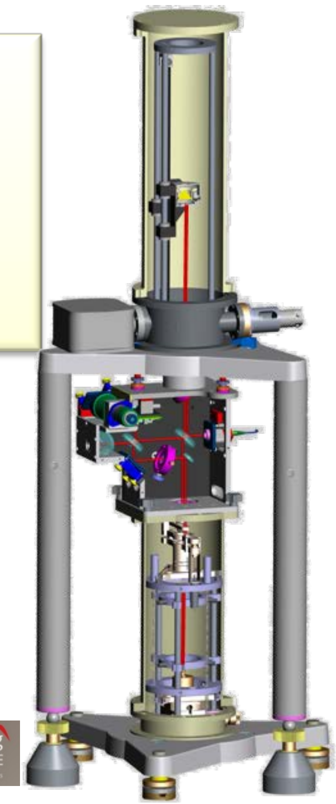
Absolute Gravimeter (AG)

- based upon physical standards
- no drift
- uncertainty: ± 25 nm/s^2
- observation epochs

Combination includes:

- SG drift determination
- Calibration
- AG: Test for offsets

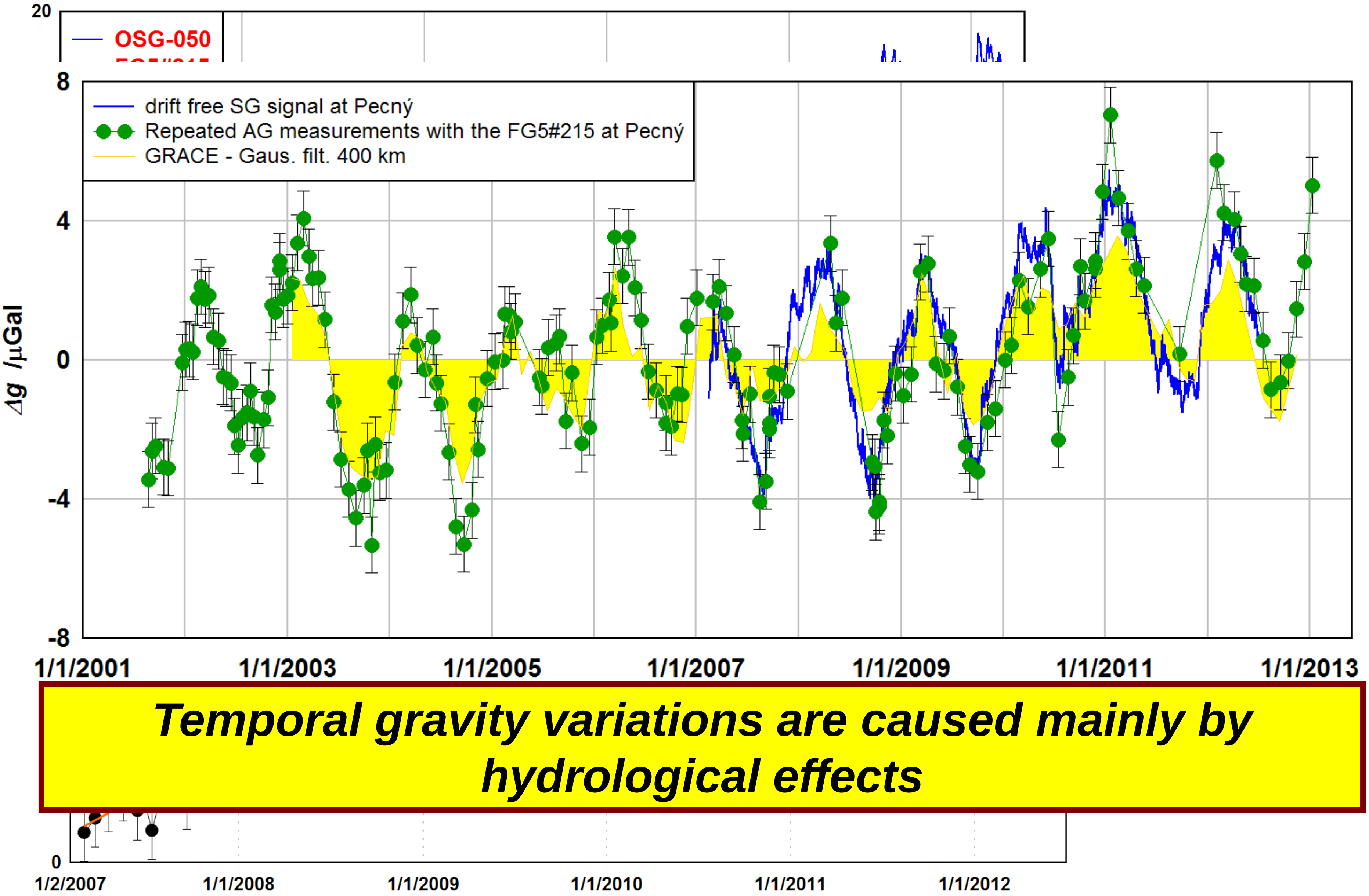
➔ **Gravity reference function** with highest resolution *and* long-term stability



International Association of Geodesy
IAG 150 years

2016, IAG Resolution (No. 2): Establishment of a Global Absolute Gravity Reference System

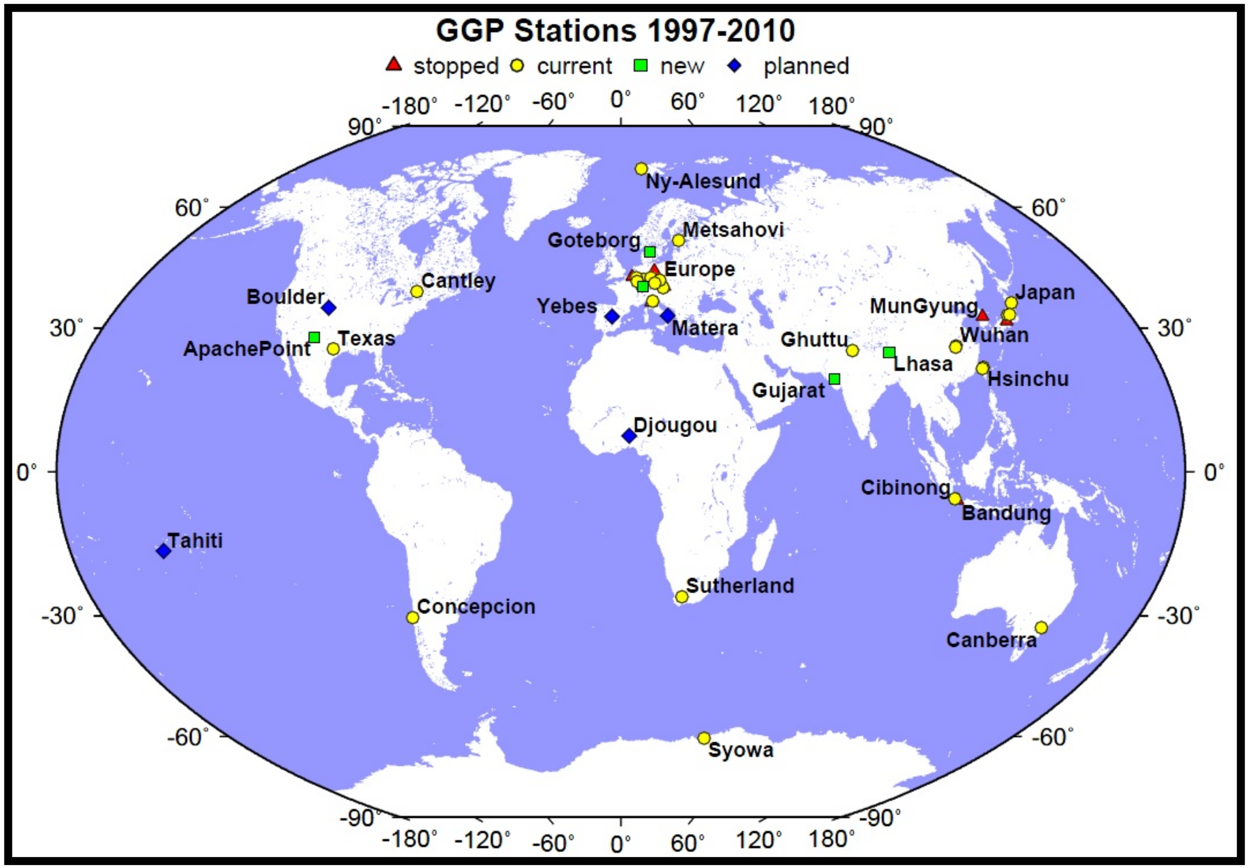
Combination of AG and SG

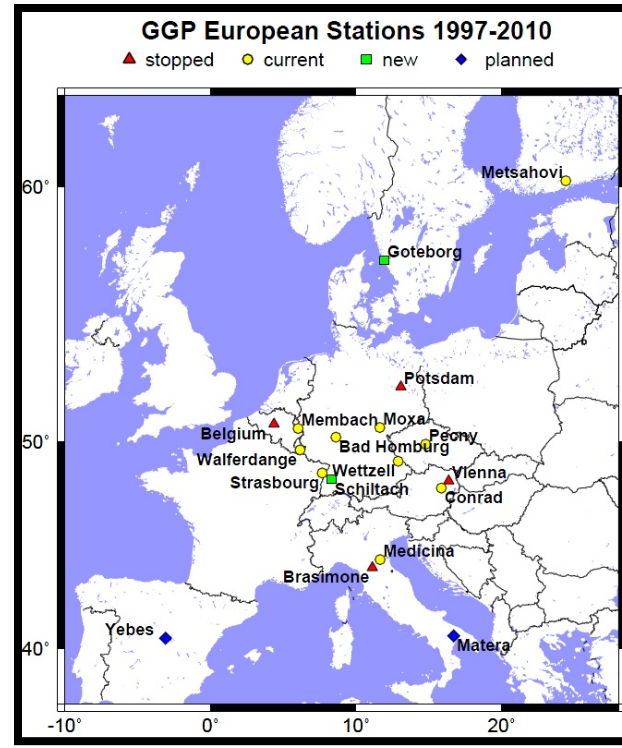


Temporal gravity variations are caused mainly by hydrological effects

International Geodynamics and Earth Tide Service (IGETS)

a Service to monitor temporal variations of the Earth gravity field through long-term records from ground gravimeters, tiltmeters, strainmeters and other geodynamic sensors





http://isdc.gfz-potsdam.de

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HELMHOLTZ CENTRE POTSDAM
GFZ GERMAN RESEARCH CENTRE FOR GEOSCIENCES

INFORMATION SYSTEMS AND DATA CENTER
Global Earth Science Data

- GRACE @ ISDC
- IGETS Data Base

ISDC ▸ Homepage

Welcome to the Information System and Data Center for geoscientific data

ISDC's online service portal is an access point for all manner of geoscientific geodata, its corresponding metadata, scientific documentation and software tools.

The majority of the data and information, the portal currently offers to the public, are global geomonitoring products such as satellite orbit and Earth gravity field data as well as geomagnetic and atmospheric data for the exploration.

The ISDC portal's design and the operation is a project of the ISDC-team within the GFZ's Data Center. We invite you to use our services and they will benefit your scientific work.

You can get data from the following projects:

- GRACE @ ISDC
- IGETS Data Base

Contact

ISDC Staff

If you have questions, problems or suggestions of any kind please don't hesitate to contact us.

Our office hours are

Monday - Thursday: 8:30 - 11:45, 12:15 - 16:00
Friday: 8:30 - 11:45, 12:15 - 15:30

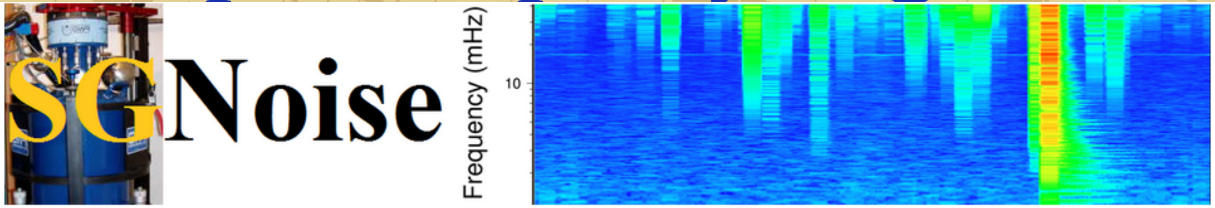
Please mail to ISDC Team.

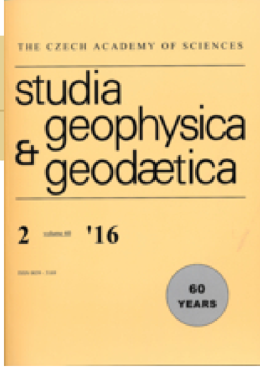
Data Products

Several SG data are available at **ISDC** at GFZ:

- Raw gravity and local pressure records sampled at 1 or 2 seconds, in addition to the same records decimated at 1-minute samples (Level 1 products).
- Gravity and pressure data corrected for instrumental perturbations, ready for tidal analysis (Level 2 products).
- Gravity residuals after particular geophysical corrections (including solid Earth tides, polar motion, tidal and non-tidal loading effects) (Level 3 products).

http://oko.pecny.cz/grav/





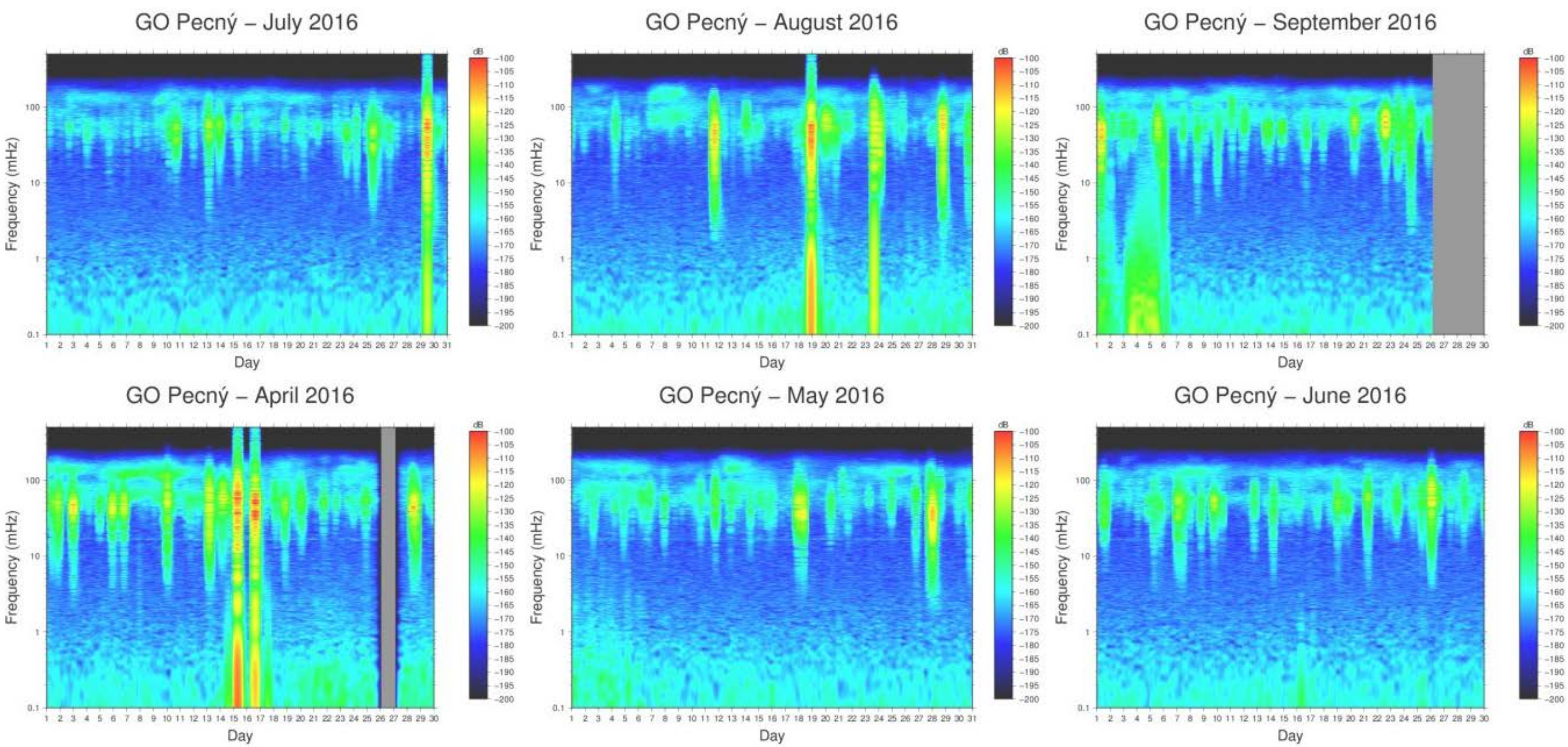
DATA QUALITY CONTROL Station: Pecný (CZ) Year: 2007 Month: November Day: 14 Quantity: Last 30 days overview Go

MONTHLY AND YEARLY OVERVIEW Station: Pecný (CZ) Quantity: MONTHLY spectrograms Go

Last 30 days overview of residuals | Last week spectral overview | Yearly overview of residuals | Yearly overview of missing data

PE - 2016

MONTHLY AND YEARLY OVERVIEW Station: Pecný (CZ) Quantity: MONTHLY spectrograms Go



Testing tidal models

Journal of Geodynamics 80 (2014) 12–19

Contents lists available at ScienceDirect

Journal of Geodynamics

journal homepage: http://www.elsevier.com/locate/jog

On the comparison of tidal gravity parameters with tidal models in central Europe

B. Ducarme[a,*], V. Pálinkáš[b], B. Meurers[c], Cui Xiaoming[d], M. Val'ko[b]

[a] Catholic University of Louvain, Georges Lemaître Centre for Earth and Climate Research, Belgium
[b] Research Institute of Geodesy, Topography and Cartography, Geodetic Observatory Pecný, Czech Republic
[c] Department of Meteorology and Geophysics, University of Vienna, Austria
[d] State Key Laboratory of Geodesy and Earth's Dynamics, Institute of Geodesy and Geophysics, CAS, Wuhan, China

Table 3
Final comparison of mean corrected tidal factors σ standard deviation on n stations, σ' standard deviation on n loading evaluations.

Station	n	O1		K1		M2		M2/O1
		δ_c	α_c (°)	δ_c	α_c (°)	δ_c	α_c (°)	
This study 3 stations		1.15350	−0.013	1.13523	0.039	1.16210	0.024	1.0075
σ	3	0.00020	0.003	0.00025	0.010	0.00006	0.013	
σ'	24	0.00024	0.010	0.00050	0.012	0.00042	0.020	
Ducarme et al. (2009) 16 stations WEN		1.15340	0.016	1.13525[a]		1.16211	0.031	1.0076
σ	16	0.00092	0.021	0.00090		0.00081	0.029	
Strasbourg		1.15308	−0.026	1.13477	0.031	1.16129	0.053	1.0071
σ'	8	0.00016	0.010	0.00051	0.012	0.00030	0.032	
DDW99/H		1.15282		1.13244		1.16049		1.0066
DDW99/NH		1.15429		1.13451		1.16199		1.0067
MAT01/NH		1.15402		1.13495		1.16159		1.0066

[a] 8 stations only (Table 5, Ducarme et al., 2009).

Global geodynamics

OXFORD JOURNALS

Geophysical Journal International

Temporal variation of tidal parameters in superconducting gravimeter time-series

Bruno Meurers[1], Michel Van Camp[2], Olivier Francis[3] and Vojtech Pálinkáš[4]

− Author Affiliations

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[2]Royal Observatory of Belgium, 3 avenue Circulaire, B-1180 Brussels, Belgium

[3]Faculté des Sciences, de la Technologie et de la Communication, University of Luxembourg, 6, rue Richard Coudenhove-Kalergi, L-1359 Luxembourg

[4]Research Institute of Geodesy, Topography and Cartography, Geodetic Observatory Pecný, Czech Republic

For the 1-yr analyses, we identified statistically significant temporal short- and long-term variations of tidal parameters, as large as 0.2‰, by applying a stacking procedure. They turn out to appear coherently at most European SG stations. It is mainly caused by insufficient frequency resolution of limited time series as 2nd and 3rd degree constituents within the M2 group respond differently to ocean loading. Therefore, we expect long-term modulation of theM2 tidal parameter in analyses of consecutive 1-*yr intervals.*

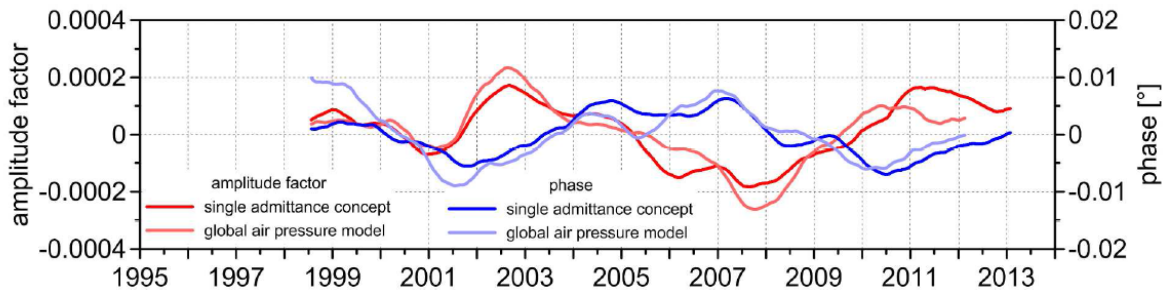


Figure 6: Stacked M2 tidal parameters obtained by different consideration of atmospheric load effects (adjustment of a constant air pressure admittance factor by tidal analysis (dark red and dark blue) or subtraction of atmospheric load effects (MOG2D model, Carrère & Lyard (2003), http://loading.u-strasbg.fr/GGP/) before tidal analysis (light red and light blue)).

Global geodynamics

Geophysical Journal International

The quest for a consistent signal in ground and GRACE gravit[y] time-series

Michel Van Camp,[1] Olivier de Viron,[2] Laurent Métivier,[3] Bruno Meurers[4] and Olivier Francis[5]

[1] *Royal Observatory of Belgium, 3 avenue Circulaire, B-1180 Brussels, Belgium. E-mail: m.vancamp@oma.be*

[2] *Institut de Physique du Globe de Paris (IPGP, Sorbonne Paris-Cité, UMR 7154, CNRS, Université Paris-Diderot), bâtiment Lamarck, Case 70[…] Hélène Brion, F-75013 Paris, France*

[3] *Institut National de l'Information Géographique et Forestière/Laboratoire de Recherche en Géodésie, Université Paris-Diderot, bâtiment Lam[…] 7011, 35 rue Hélène Brion, F-75013 Paris, France*

[4] *Department of Meteorology & Geophysics, University of Vienna, Althanstrasse 14, UZA II, 2D504, A-1090 Vienna, Austria*

[5] *Faculté des Sciences, de la Technologie et de la Communication, University of Luxembourg, 6, rue Richard Coudenhove-Kalergi, L-1359 Luxe[…]*

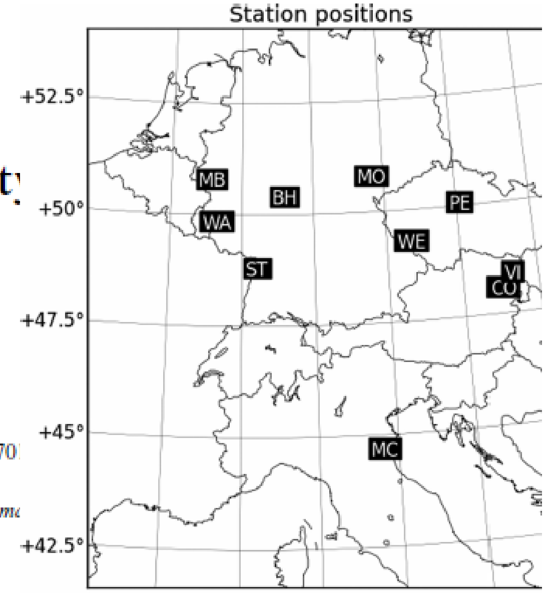
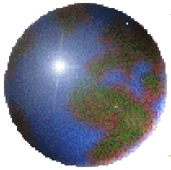


Figure 1. Map showing the location of the SG stations used in this stu[dy]; see Table 1 for details.

Chapter
Observing our Changing Earth
Volume 133 of the series International Association of Geodesy Symposia pp 523-532

European Tidal Gravity Observations: Comparison With Earth Tide Models And Estimation Of The Free Core Nutation (Fcn) Parameters

B Ducarme, S Rosat, L Vandercoilden, Xu Jian-Qiao, Sun Heping



Free oscillations of the Earth

Geophysical Research Letters
AN AGU JOURNAL
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Solid Earth

Constraints on the centroid moment tensors of the 2010 Maule and 2011 Tohoku earthquakes from radial modes

E. Zábranová, C. Matyska, L. Hanyk, V. Pálinkáš

[1]Department of Geophysics, Faculty of Mathematics and Physics, Charles University in Prague, Prague, Czech Republic.
[2]Research Institute of Geodesy, Topography and Cartography, Zdiby, Czech Republic.

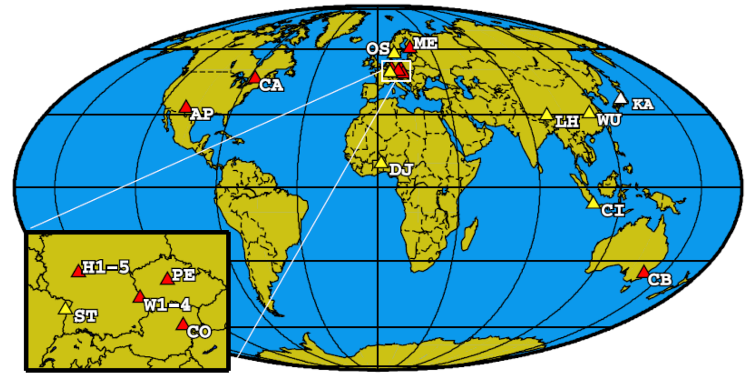


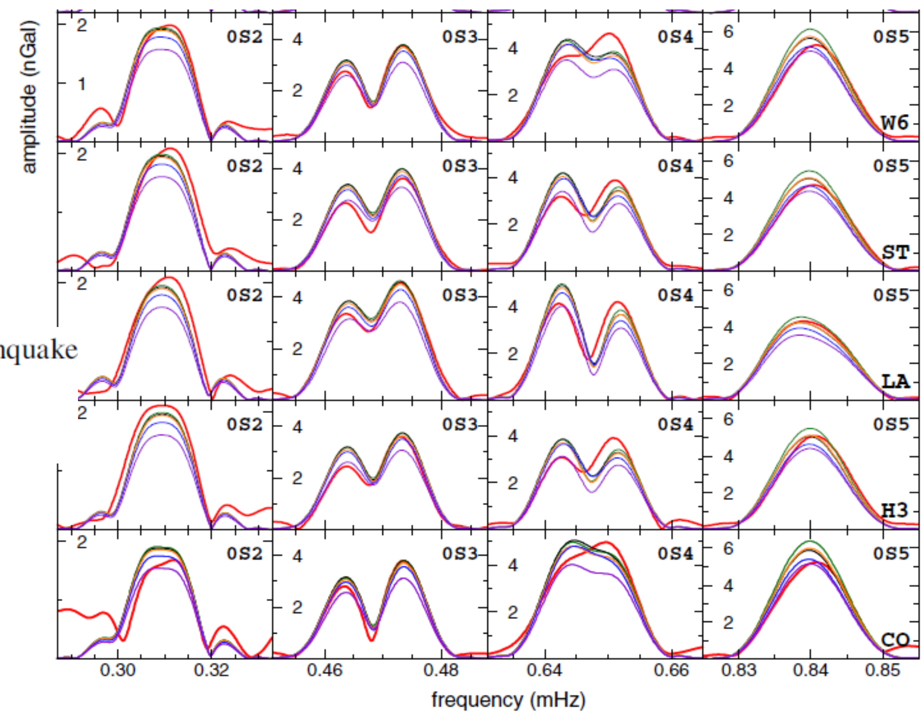
Figure 1. The triangles represent the SG sites used in this study. Red ones were employed for both events, white only for the 2010 Maule earthquake and yellow only for the 2011 Tohoku earthquake.

Pure and Applied Geophysics

Low-Frequency Centroid Moment Tensor Inversion of the 2015 Illapel Earthquake from Superconducting-Gravimeter Data

Eliška Zábranová[1] and Ctirad Matyska[1]

[1] Department of Geophysics, Faculty of Mathematics and Physics, Charles University in Prague, V Holešovičkách 2, 18000 Prague, Czech Republic. E-mail: eliskazabranova@centrum.cz



Metrology

Proposed **re-definition of the mass unit „kilogram"** based on the Plank constant. Realization of „kilogram" by watt-balance experiments ⇒ **<u>free-fall acceleration</u>** must be determined with an uncertainty of 5μGal.

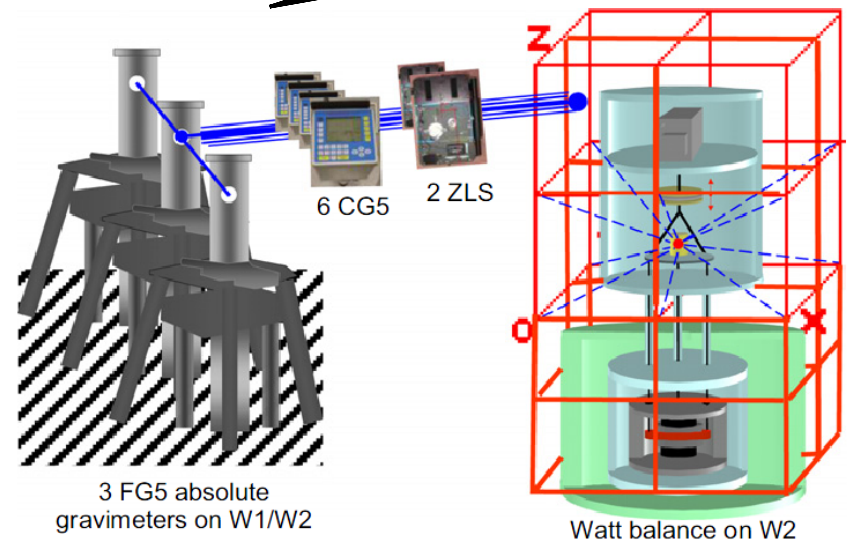


Figure 2. Gravity measurements in the WB laboratory. The 3 AGs occupied W1 and W2 and the 8 RGs measured the ties between W1 and W2 at the five levels and the 3D grid around the WB.

$$U\ I = \frac{U_1 U_2}{R} = C_{el}\ f_1\ f_2\ h$$

⇩

$$U I = m\ g\ v$$

⇨

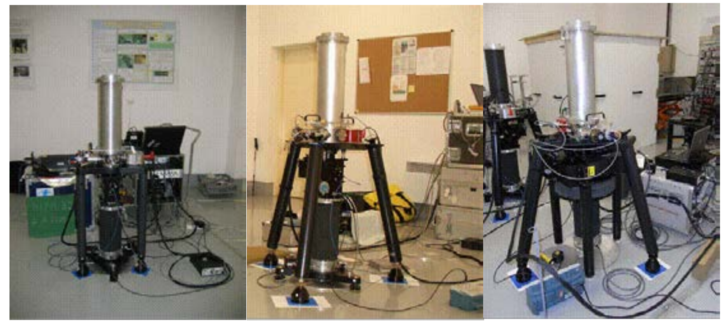
$$h = \frac{m\ g\ v}{C_{el}\ f_1\ f_2}$$

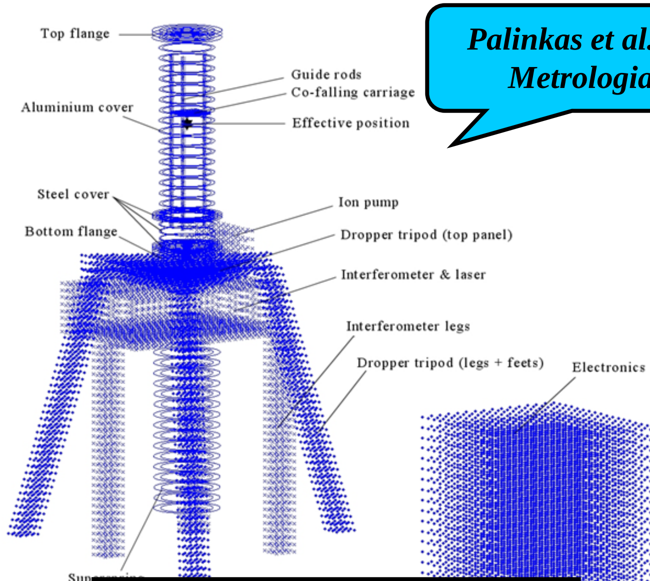
Systematic errors of *g* measurements have to be uncovered

Systematic errors

SELF ATTRACTION

FG5 components	SAE/µGal	FG5 model		
		Bulk	Fiber I	Fiber II
VACUUM CHAMBER	**0.36**	•	•	•
Aluminum part of the chamber	-0.15			
Steel part of the chamber	0.59			
Ion pump	0.20			
Guide rods	0.02			
Co-falling carriage	-0.30			
DROPPER TRIPOD I	**0.46**	•	•	
Top panel	0.34			
Legs + feet	0.12			
DROPPER TRIPOD II	**0.36**			•
Top panel	0.25			
Legs + feets	0.11			
INTERFEROMETER – BULK	**0.82**	•		
Interferometer + laser	0.78			
Legs	0.04			
INTERFEROMETER – FIBER	**0.27**		•	•
Interferometer	0.22 / 0.23			
Tripod below superspring	0.05			
SUPERSPRING	**0.10**	•	•	•
ELECTRONICS	**0.03**	•	•	•
SAE /µGal		**1.77 ± 0.22**	**1.22 ± 0.22**	**1.14 ± 0.22**





Palinkas et al. 2012, Metrologia 49

DIFFRACTION **TEST MASS ROTATION** **FLOOR RECOIL**

INTERFEROMETER **ELECTRONICS** **VERTICALITY**

RESIDUAL AIR PRESSURE **MAGNETIC SENS.** **FINITE SPEED OF LIGHT**

Electronic effects

IOP Publishing | Bureau International des Poids et Mesures Metrologia

Metrologia 53 (2016) 27–40 doi:10.1088/0026-1394/53/1/27

On the effect of distortion and dispersion in fringe signal of the FG5 absolute gravimeters

Petr Křen[1], Vojtech Pálinkáš[2] and Pavel Mašika[1]

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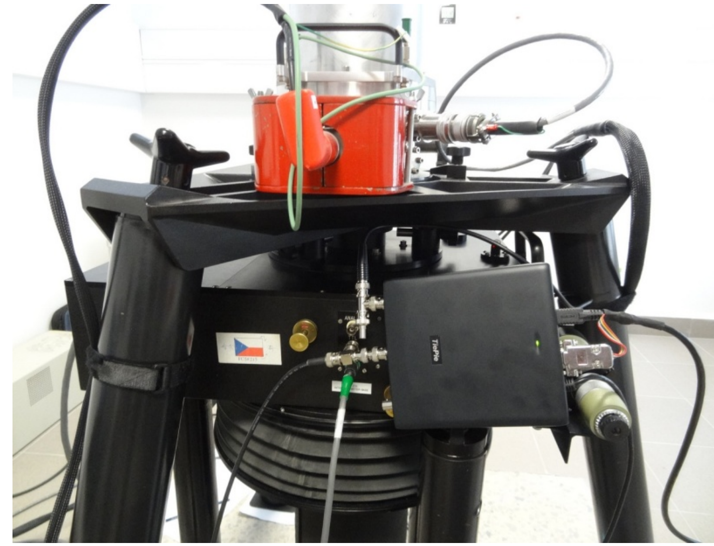
[2] Research Institute of Geodesy, Topography and Cartography, Geodetic Observatory Pecný, 25165 Ondřejov 244, Czech Republic

E-mail: pkren@cmi.cz



The analogue-to-digital converter HS5 (TiePie Handyscope HS5-530XMS) with the bandwidth of 250 MHz is used to digitize the fringe signal. The fixed voltage range and dc coupling is used to avoid the high-pass filter effect of ac coupling on the measurements. We are using the sample rate of 100 MS s^{-1} that allows FG5 triggered recording of the complete fringe signal generated during the free-fall of 0.2 s to the 32 MSamples memory of HS5.

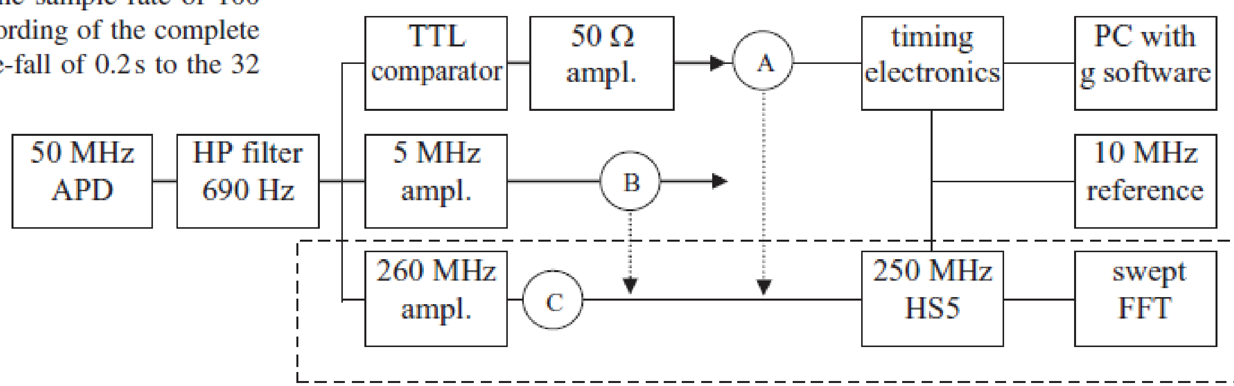


Figure 1. The measurement scheme of the standard FG5 system and the experimental HS5 system (dashed box). Both systems use the same APD, high-pass filter and the 10 MHz timing reference. The HS5 system allows signal processing from three outputs: TTL signal output (A), built-in analogue output (B) and new fast analogue output (C).

Thank you for your attention!

New gravity lab and gravimeter at the Pecný station