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The Geophysical and Geodynamic Effects in Tidal Gravity Measurements
Taken with Spring Gravimeter at Józefosław, Poland

Introduction

Figure. Location of Józefosław Observatory

In this poster we will discuss the results of tidal measurements taken with LaCoste&Romberg Earth Tide spring gravimeter. The measurements were collected in Józefosław, suburb area of Warsaw. The long time series (more than 3 years) allow to study subtle geodynamics and geophysical effects. Firstly we give some the discussion concerning importance of atmospheric effects in gravity which are, after tides, the main source of disturbance. This effect can reach as much as ten μGals. We examine here two approaches using single admittance factor and using regional pressure field. Next we examine appropriateness of ocean tidal loading corrections (OTL). Despite the small values of a few nm s^{-2} we are able to clearly observe the small OTL effects in gravity records. We present also some results of observation of Earth free oscillation which are triggered with great Earthquakes. Even the gravest fundamental modes are fairly well resolvable and their frequencies are in good agreement with theoretical ones. The tiny effect of Free Core Nutation (FCN) was also found in enhancements of tidal parameters in diurnal band. The results for FCN period and quality factor are, despite high noise level in measurements, with good agreement with previous determination. The presented results shows that gravity measurement are the great source of information in many areas of Earth sciences. Besides of shortcomings of spring gravimeters we showed that they still can be useful in tidal and non-tidal gravity studies.

Gravity phenomena

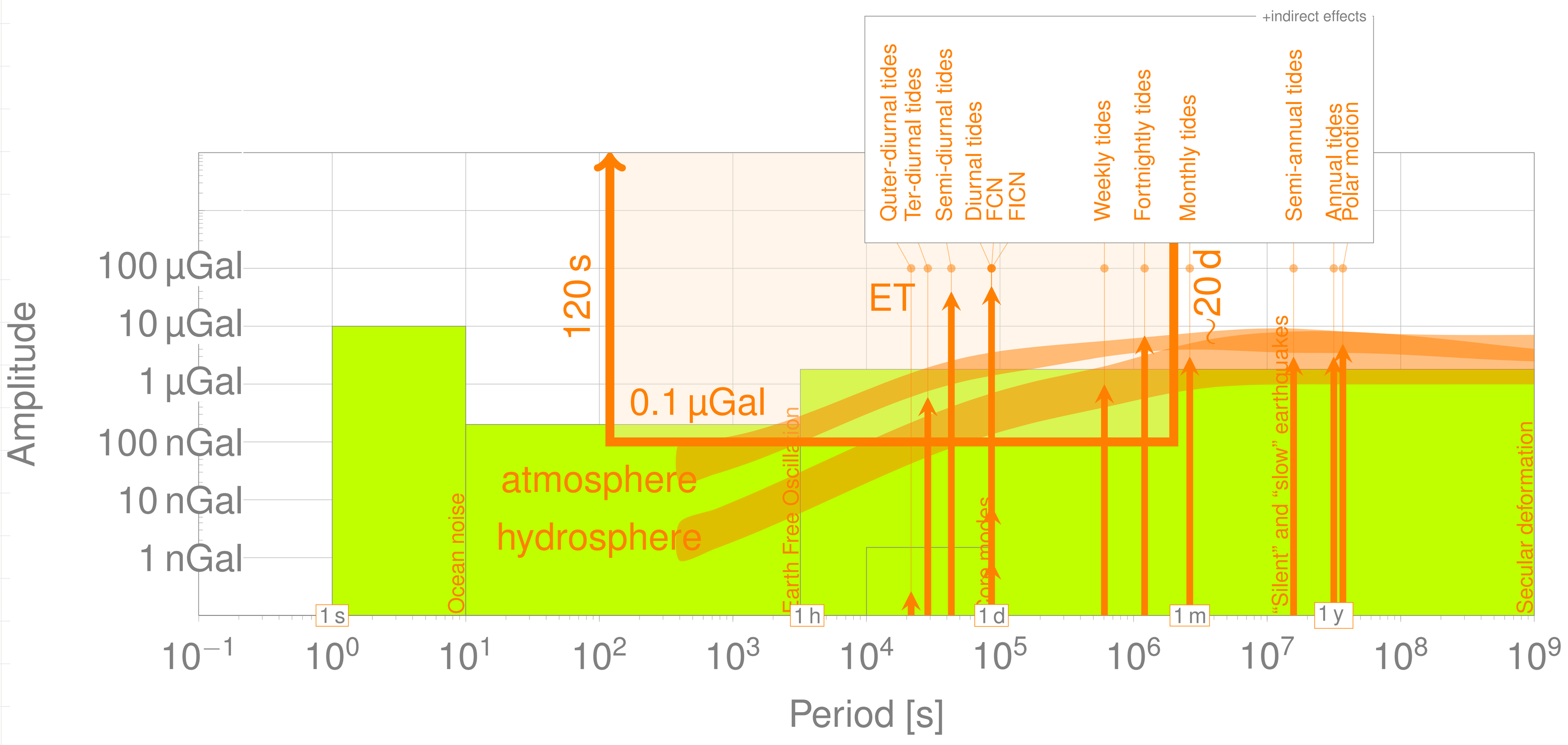


Figure. Gravity phenomena and LaCote&Romberg Earth Tide gravimeter no. 26 capability for capturing signals (after Hinderer and Crossley, 2004)

Anthropogenic noise

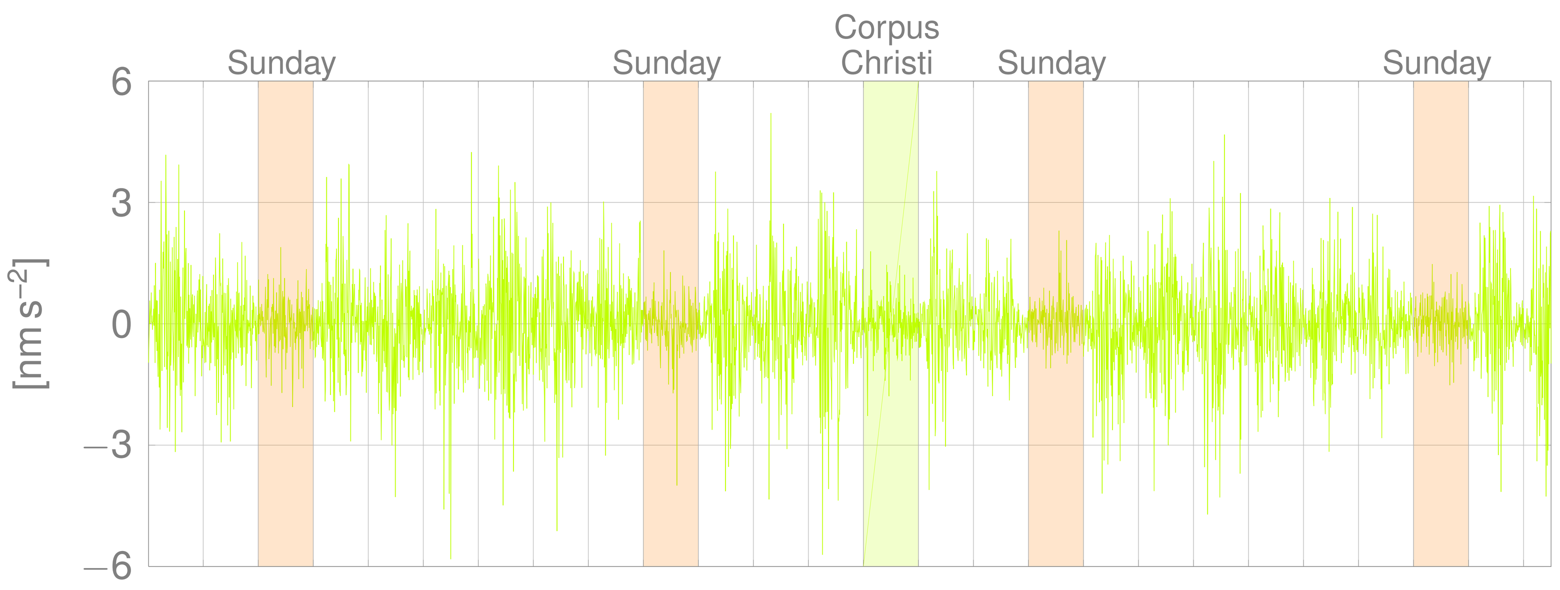


Figure. Time derivative of gravity residuals (tides, ocean loading and pressure effects removed)

Atmosphere (admittance)

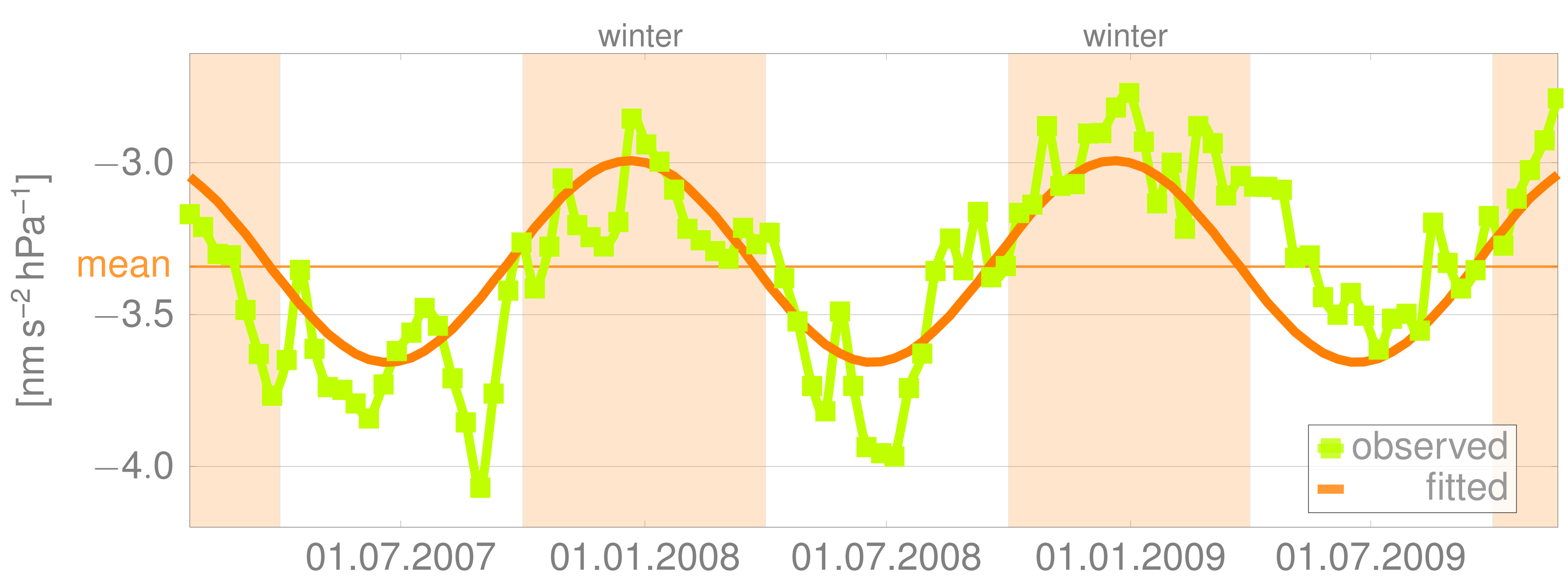


Figure. Seasonal variation of admittance factor (upper graph) and the difference in term of gravity correction when compared to single constant value

Atmosphere (frequency dependent)

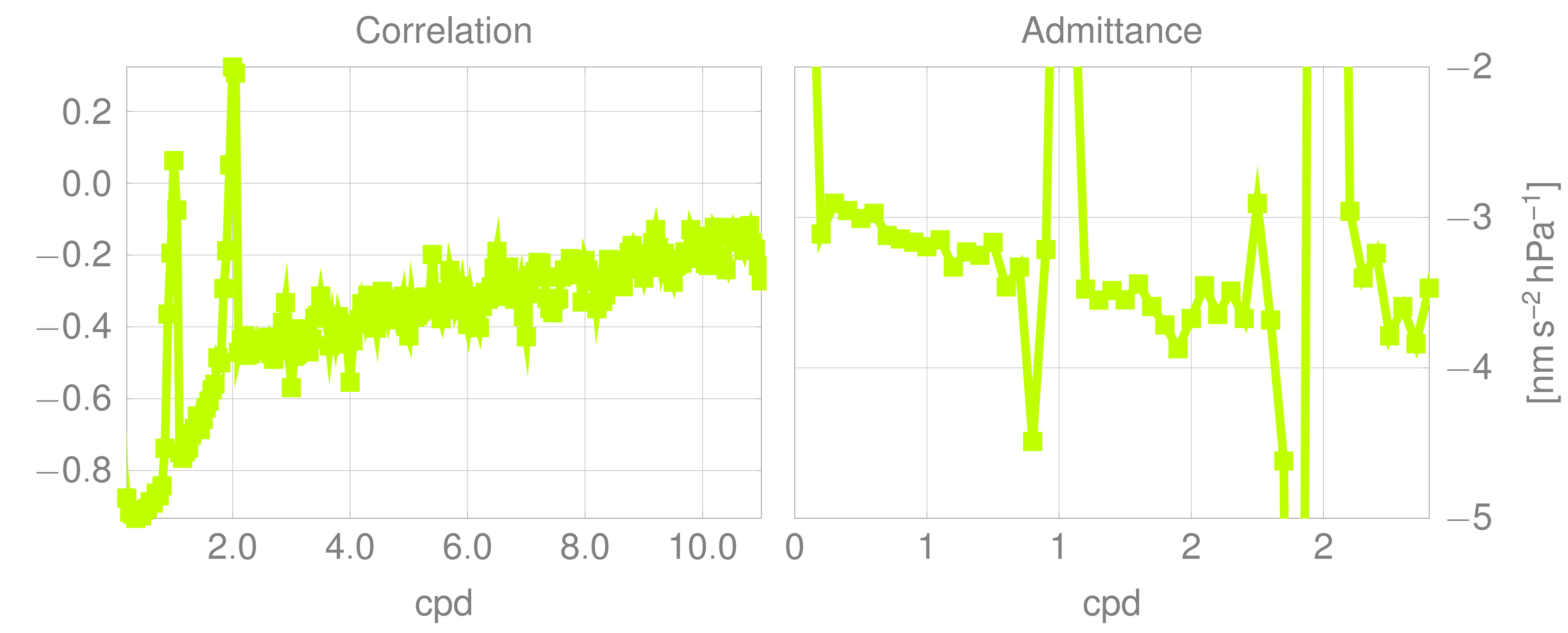


Figure. Correlation coefficient (left graph) and admittance factor (right graph) from frequency dependent analysis

Earth free oscillations (amplitude spectra)

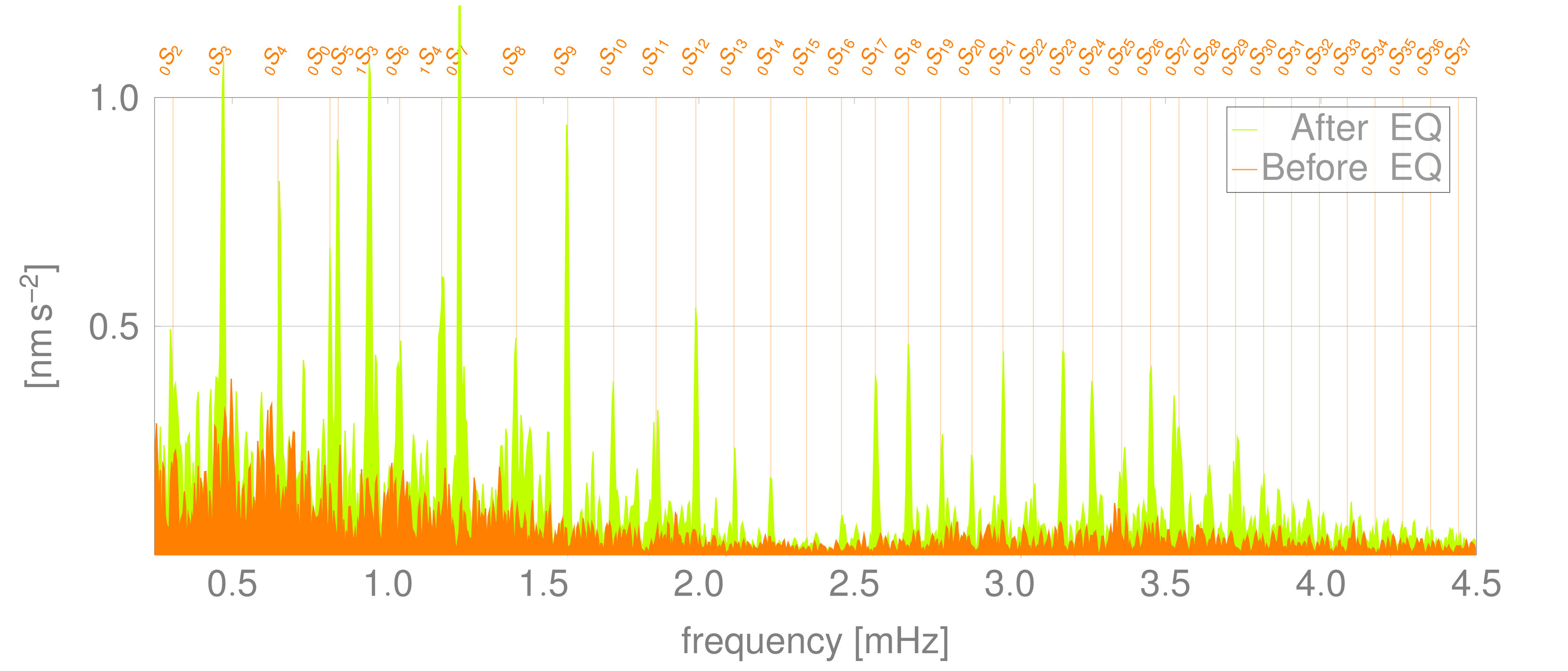


Figure. Amplitude spectra from about 5h to 43h after Chilean (2010) earthquake. For comparison the spectra from window of 48 length before earthquake (red-orange) are shown

Earth free oscillations (Q factors)

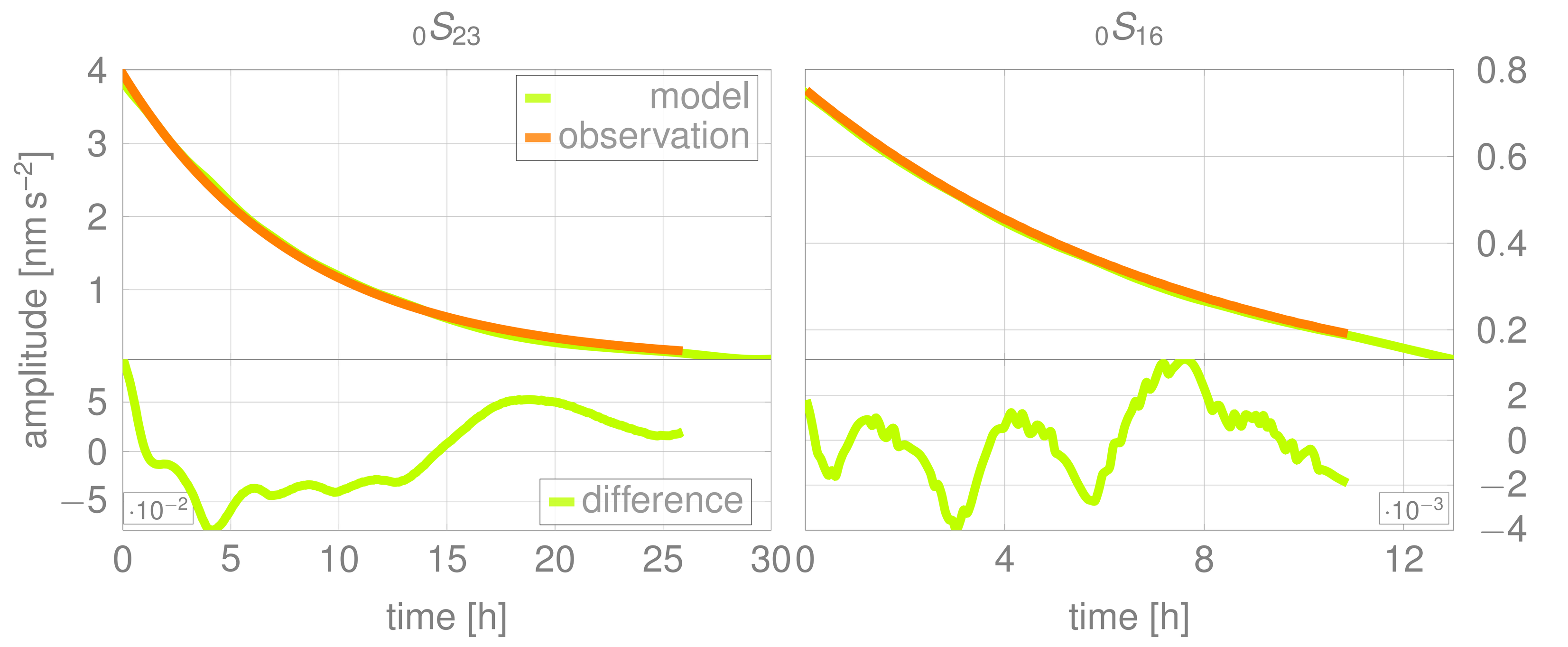


Figure. Fitted exponential regression function for two modes. The estimated Q value for $_0S_{23}$ is 293 comparing to theoretical value of 259. For $_0S_{16}$ we found 284 when the expected from Earth model is 325 respectively

Free Core Nutation and Quality Factor

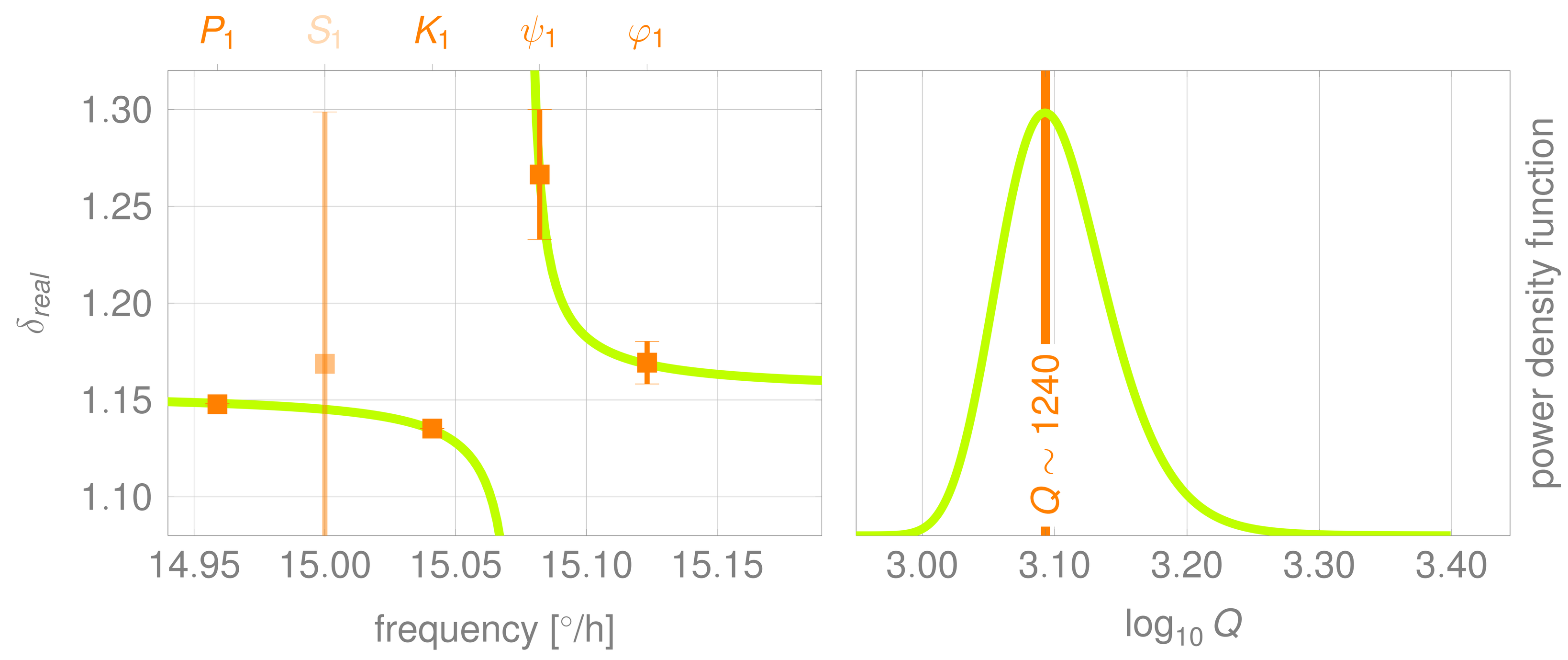
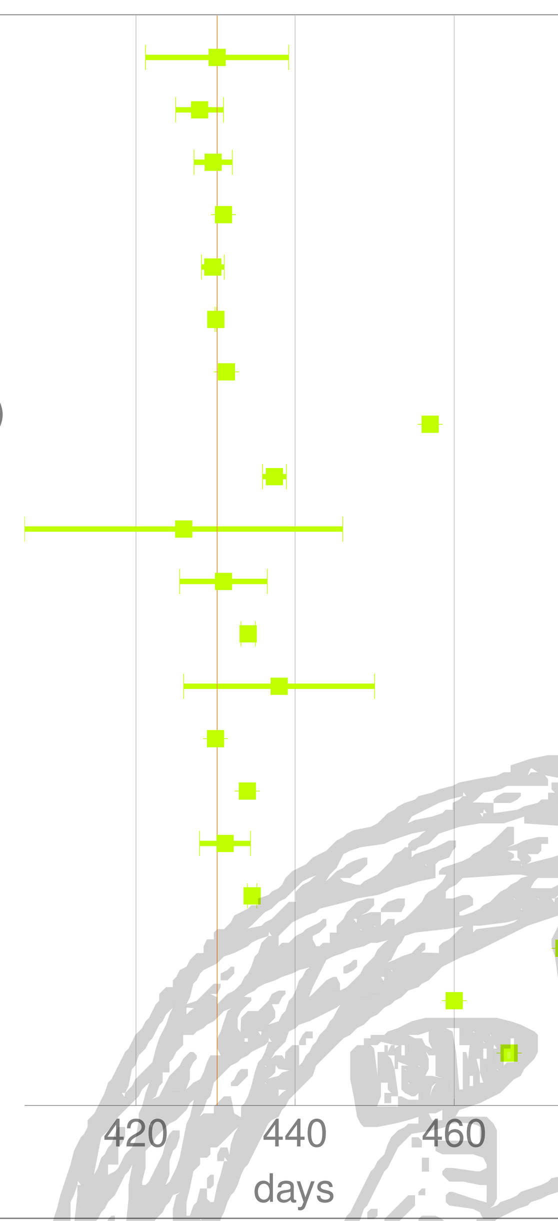


Figure. Resonance curve fitted to gravimetric factors and quality factor determined with bayesian method

FCN (result)

Table. Comparison of FCN period determination from different studies

Author	Method
this study	gravity
Rosat *et al.* (2009)	gravity
Ducarme *et al.* (2007)	gravity
Sun *et al.* (2004)	gravity
Sato *et al.* (2004)	gravity
Mathews *et al.* (2002)	VLBI
Dehant *et al.* - hydrostatic (1999)	theory
Dehant *et al.* - nonhydrostatic inelastic (1999)	theory
Neumeyer and Dittfeld (1997)	gravity
Haas and Schuh (1996)	VLBI
Jiang and Smylie (1995)	VLBI
Defraigne*et al.* (1994)	combined
Cummins and Wahr (1993)	gravity
Herring *et al.* (1991)	VLBI
Neuberg *et al.* (1990)	gravity
Richter and Zurn (1988)	gravity
Herring *et al.* (1986)	VLBI
Wahr and Bergen (1986)	theory
Wahr (1981)	theory
Sasao *et al.* (1980)	theory



Conclusions and Acknowledgements

In the era of Superconducting gravimeters the spring type can also give valuable results.

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