

# Development of tidal gravity records in Poland within the framework of the EPOS-PL project

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### **European Union**

European Regional Development Fund



### EPOS - European Plate Observing System POIR.04.02.00-14-A0003/16

Priority IV: INCREASING THE RESEARCH POTENTIAL Action 4.2: DEVELOPMENT OF MODERN RESEARCH INFRASTRUCTURE OF THE SCIENCE SECTOR

Period of realization: 2016 - 2021 Project value: 61 996 279,64 PLN ERDF co-financing: 46 632 332,69 PLN

**Beneficiary:** 



Instytut Geofizyki Polskiej Akademii Nauk



PROJECT **EPOS - EUROPEAN PLATE OBSERVING SYSTEM** IS CO-FINANCED BY THE EUROPEAN UNION FROM THE FUNDS OF THE EUROPEAN REGIONAL DEVELOPMENT FUND (ERDF)







### **Presentation overview**



- EPOS-PL Project
- CIBOG Gravimetric Observations Research Infrastructure Center
  - data repository
- Tidal gravity observations in Poland
  - begining of EPOS-PL project (2017.01)
  - current state (2021.03)
- Support of the tidal infrastructure
  - gravimeter calibration
- GRAV-PL\_TIDE data repository
  - data acquisition
  - processing products









# **EPOS-PL** project



#### **Consortium members:**

- Institute of Geophysics PAS (IG PAS) Coordinator
- Academic Computer Centre CYFRONET AGH University of Science and Technology (ACC Cyfronet AGH)
- Central Mining Institute (CMI)
- Institute of Geodesy and Cartography (IGC)
- Wroclaw University of Environmental and Life Sciences (WUELS)
- Military University of Technology (MUT)
- Polska Grupa Gornicza (PGG)









### **EPOS-PL** overview



#### **RESEARCH PROGRAM OF EPOS-PL**

The <u>first</u> layer of the Research Infrastructure is built by so-called Research Infrastructure Centers (RICs). RIC provides a complete dataset concerning given research field (e.g. seismic data, geodetic data, gravity data, geological data)

RICs included in this layer:

- **CIBIS** Induced Seismicity Research Infrastructure Center
- **CIBOGM** Geomagnetic and Magnetotelluric Observations Research Infrastructure Center
- **CIBAL** Analytical Laboratories Research Infrastructure Center
- **CIBDG** GNSS Data Research Infrastructure Center

- **CIBCBL -** Lithospheric Research Infrastructure Center
- GGOS-PL++ Global Geodetic Observation System in Poland













### **Gravimetric Observations Research Infrastructure Center**

Gravity database for: absolute, tidal and satellite observations created within the **EPOS-PL** project:

- **GRAV-PL ABS** absolute gravity observations
- **GRAV-PL SAT** processing products of satellite gravity missions
- **GRAV-PL TIDE** tidal gravity observations
  - Archive and near real-time data from available tidal gravimeters in Poland
    - > EPOS-PL, EPOS-PL+ financed infrastructue
    - > Infrastructure financed outside of these projects



















### Tidal gravity observations in Poland (2017-2020)

- Development of the research infrastructure for tidal gravity observations within the years 2017-2020:
  - o new instruments at new locations
  - o new instruments at old locations
  - o old instruments at new locations
  - o old instruments at old locations
- Gravity database assumption:
  - collect gravimetric tidal observations within the GRAV-PL\_TIDE repository which are at least 6 months in length





























- unified reference system
  - o unified methodology for gravimeter calibration
  - o absolute gravity measurements (regularly performed wherever possible)
- Multiple tests at the Borowa Gora Geodetic-Geophysical Observatory resulted in unified methods for gravimeter calibration and drift control:
  - tidal gravimeter calibration performed with simultaneous records with LaCoste&Romberg gravimeters
    - ✓ at least 2 gravimeters (independent solutions)
    - ✓ at least 40 days of simultaneous records
  - regular absolute gravity determinations
    - ✓ every six months (MUSE polygons)
    - ✓ for long term drift evaluation of gPhoneX gravimeters





























#### Support of the tidal infrastructure

gPhoneX-157, LCR G-1012, LCR G-1036 (Katowice) – 2019.06.06 - 2019.07.31 (~55 days) – 1Hz record











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# **CIBOG - Gravimetric Observations Research Infrastructure Center**



- data preparation (TSoft)  $\geq$ 
  - drift reduction high pass filtering (0.6 cpd cutoff) 0
  - unified pairs of data from LCR to gPhoneX gravimeters Ο
  - scale factor obtained with the least squares adjustment 0





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gravimeter	date	<i>k</i> ± <i>m</i> <sub><i>K</i></sub>
iGrav-027 (Borowa Góra)	2016 – 2020	-1061.66 ± 0.11
gPhoneX-155 (Rybnik)	2019.04 - 2019.06	$1.00337 \pm 0.00033$
gPhoneX-157 (Katowice)	2019.06 - 2019.07	$0.99642 \pm 0.00037$
gPhoneX-164 (Wrocław)	2020.10 - 2021.01	$0.99949 \pm 0.00010$











#### **GRAV-PL\_TIDE data repository** (data acquisition)

- operation is based on a selfmade software for:
  - recieving and organizing datasets
  - processing between consecutive levels
- data format used in the reposository .tsf
  - most commonly used format in the gravity community delivered by majority of instruments
- acceleration of gravity unit used [nm/s<sup>2</sup>]
  - unification of units coming from the instruments (µGal, mGal, Volt)
- considered in the future
  - 1 minute data (averaged) all instruments
  - IGETS automatic upload –1Hz data, format .ggp all instruments
  - IRIS 1Hz data, format miniSEED all instruments











### GRAV-PL\_TIDE data repository (processing products)

- Level 0 raw complete incoming data in arbitrary format (*instrumental parameters* 5-21 *channels*) with maximum frequency of 1 Hz to 5 Hz
- Level 1 Level 0 corrected for file structure errors and converted to .tsf format. Verification includes: file structure, correctnes of records, file completness
- Level 2 Level 1 reduced to 2 channels: gravimeter reading, ambient pressure (gravimeter reading corrected for instrumental effects)
- Level 3 basic processing product. Level 2 with added channels containing gravimetric effects models: body tide (*Tamura*), ocean tidal loading (*FES04*) i barometric (*IAG*, 1983) + channel reduced for the above effects
- Level 4 dedicated processing product

























GRAV-PL\_TIDE data repository (Level 0/Level 1 data – 2 days)





