IAG Newsletter

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- I. General information
- II. Reports of IAG symposia
- III. Reports by commissions, special commissions or study groups
- IV. Symposia announcements
- V. Book reviews
- VI. Fast bibliography

General Announcements

The disturbing gravity potential at four IHRF stations in the São Paulo state

In order to collaborate with the establishment of the International Height Reference Frame (IHRF), the Polytechnic School of the University of São Paulo, Department of Engineering Transportation (EPUSP-PTR), addressed an effort to estimate the disturbing and the gravity potential at four stations in the São Paulo state.

The study was performed considering the radius of 110 and 210 km around the computation point, aiming to evaluate

the convergence of the results for both cases. The Residual Terrain Model (RTM) technique has been applied for the estimation of the short wavelength component.

The selected stations (Fig. 1) have a good gravity coverage and they are part of the Brazilian Network for Continuous GNSS Monitoring (RBMC). Absolute gravity values were also measured at the points with A-10 Micro-g LaCoste absolute gravimeter. Then station of Presidente Prudente (PPTE) is proposed for the global network and the other three, Botucatu (SOBO), São Carlos (EESC) and São José do Rio Preto (SJRP), are part of a local network.

The computation has been carried out solving the second geodetic boundary value problem using numerical integration. The program, developed at EPUSP, named HOTINE_5MIN, uses the modified Hotine integral to compute the short wavelength component of the disturbing potential (T_P).

The geopotential model GOCO05S was used as the reference field with degree and order 100 and 200, according to the integration radius. For the RTM, the version SRTM15_PLUS was used. The disturbing potential values are shown in Table 1.

The results, as expected, have shown a high dependence on the long wavelength components of the disturbing potential, but not homogeneously. The MGG T_P values used in the restore procedure have a difference between order and degree 100 and 200 of 4.98 and $-3.82 \text{ m}^2 \text{ s}^{-2}$ in Presidente Prudente and São Carlos stations, respectively. However, at Botucatu and São José do Rio Preto, this difference is -1.50 and $0.54 \text{ m}^2 \text{ s}^{-2}$. On the other hand, the T_P values of the São José do Rio Preto station (line 5 of Table 1) showed the proximity of the results of T_P with nmax: 100 and 200. The values for gravity potential are shown in Table 2.

The RTM technique showed the importance of considering the high frequencies of the gravity field for the reduction of residues and the convergence of results between achievements in a radius of 110 and 210 km. Some further studies will be carried out with high spatial resolution DTMs, as well as different MGGs models. Attention will be given to least square collocation to compare with numerical integration.

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Fig. 1 São Paulo IHRF stations

Table 1 T_P computed ($\text{m}^2 \text{s}^{-2}$)

GOCO05S	$n_{\text{max}}: 100$	$n_{\text{max}}: 200$
Botucatu	− 48.60	− 49.83
Presidente Prudente	− 52.05	− 47.04
São Carlos	− 56.31	− 60.57
São José do Rio Preto	− 65.30	− 65.28

Table 2 Gravity potential of IHRF stations ($\text{m}^2 \text{s}^{-2}$)

GOCO05S	$n_{\text{max}}: 100$	$n_{\text{max}}: 200$
SPBO	62,628,902.20	62,628,900.98
EESC	62,628,676.70	62,628,672.44
PPTE	62,632,537.93	62,632,542.94
SJRP	62,631,486.70	62,631,486.72

Valéria Cristina Silva
 Denizar Blitzkow
 Ana Cristina Cancoro Oliveira de Matos

Editor's note: This is a corrected version of the report which appeared incompletely in the last Newsletter.

25 years of continuous measurements of gravity in Membach

On August 4, 2020, the superconducting (or cryogenic) gravimeter has been measuring for 25 years the variations of gravity with a precision of one-hundredth of a billionth (10^{-11}) of g ($g = 9.81 \text{ m s}^{-2}$).

Since September 18, 2017, this instrument holds a double world record, in gravimetry and physics:

1. Record of the cryogenic gravimeter that has operated the longest at a given location;
2. It is also, as far as we know, the longest levitation of a superconducting artifact in a magnetic field. This field is generated by persistent currents, which were injected in 1995 into superconducting coils, where they circulate since then without any resistance and therefore without ever having been dissipated. Although this record does not contradict what physicists specializing in persistent currents expect—in theory, a superconducting current can flow forever—it is at least worthy of a place in a “cabinet of curiosities.”

In the field of geophysical research at the Observatory, these measurements are important, among other things because they provide insight in long-term variations in gravity, still poorly understood, caused by slow tectonic movements or climatic variations. It is also important for the study of the water cycle whose varying masses influence gravity.

To date, this gravimeter participates in many research projects, and the Royal Observatory of Belgium hopes to be able to perform this type of measurement for many years to come.

The superconducting gravimeter is located at the end of a 132-m-long gallery, 48 meters underneath the surface, in Membach (city of Baelen, eastern Belgium). The instrument sensor is immersed in liquid helium in which the temperature is held at -269°C , in other words 4 degrees above absolute zero, allowing superconductivity. *Photo credits: E. Coveliers (gravimeter and gallery); B. Frederick (Sensor)*

Exploded view of the sensor of a superconducting gravimeter: the 4-g hollow sphere levitates in a magnetic field generated by currents flowing through the pair of coils. Photograph of the sensor from the old instrument of Uccle, today on display at the Planetarium. *Photo credit: E. Coveliers and ORB-KSB. Copy authorized with mention of the source*

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