

Development of an OSI Software Package for Gravitational Field Mapping Data Processing

Sampietro D^(1,2), Capponi M⁽¹⁾, Merlo R⁽³⁾, Terruzzi M⁽³⁾, Koivisto E⁽⁴⁾ and Gaya Pique L⁽⁴⁾

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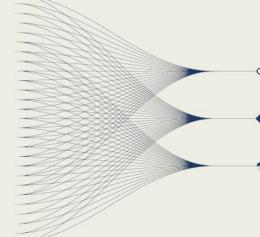




••••••• AND MAIN RESULTS

Gravitational field mapping (GRV) can support CTBTO On-Site Inspections by revealing anomalies linked to underground nuclear explosions. Since these signals can be very small, accurate processing is essential.

We developed a Python package with a user-friendly interface that, by applying all needed corrections, can help the inspection team to obtain and visualize reliable corrected gravity data.





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Introduction

Gravitational field mapping (GRV) is one of the techniques available to CTBTO On-Site Inspections (OSI) to search for evidence of underground nuclear tests. Gravity anomalies generated by cavities, collapse zones, or petrophysical changes can be extremely small and easily masked by instrumental or environmental effects. Therefore, accurate data processing is essential, including instrumental corrections, timevariable as well as external factors corrections.

In this framework, we developed a Python software package, based on open-source libraries, that integrates the full correction chain into a simple and intuitive graphical interface. The tool allows import of raw data from gravimeters, with focus on the Scintrex CG6 recently acquired by the CTBTO, application of all instrumental, temporal, and external factors corrections, and visualization of results in different formats.

The main goal is to provide the inspection team with a user-friendly solution delivering reliable and comparable gravity values, thus enhancing the detection of anomalies that, combined with other geophysical methods used within an On-Site Inspection, can contribute to the identification of underground nuclear tests.

Method

The software applies the full set of standard gravity corrections to ensure reliable gravity field data:

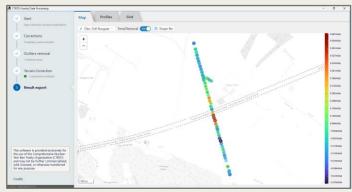
- Instrumental corrections: calibration factor, instrumental drift and absolute gravity;
- Time variable corrections: tidal and atmospheric pressure effects;
- External factors corrections: latitude, free-air and simple and full Bouguer reductions.

	iravity Data Processing			
	Start Input directory structure preparation.	Instrumental and time variable effects		
3	Corrections	Calibration factor: G G Calibration factor from files Solve and factor for the file to		
	9 enabled, none excluded.	Tides: O C		
3	Outliers removal No outliers removed.	Atmospheric pressure: (a) (1) (2) Pressure data is retrieved from file Folks_Pressure.htt		
1	Terrain Correction Computing terrain correction	Instrument drift: O		
	Result export	Absolute gravity: O Q No data for absolute gravity.		
		External factors		
		Latitude correction: The Earth is essentially a spheroid, with a slight flattening (~0.3%) at the poles. At the surface of the Earth the mean value of grawing is 9.90 m/s ² . At the equator it reduces to about 9.76 m/s ² , and at the poles		
		increases to about 9.83 m/s ² , reflecting the fact that one is farther from the center of the Earth at the equator than at the poles. This correction includes both the Newtonian attraction of the Earth as a sphe and the centrifugal force caused by its rotation about its asis.	roid	
is so	oftware is provided exclusively for e of the Comprehensive Nuclear-	Simple Bouguer: (COL) (C)		
t-B d m d, li	an Treaty Organization (CTBTO) ay not be further commercialized, censed, or otherwise transferred y purpose.	full Bougues 😘 🐧 😙		
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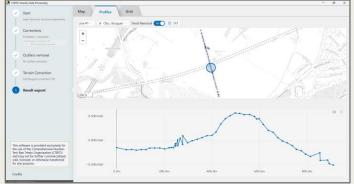
Outlier removal is supported through statistical tests on variance, tilt, and a chi-square approach, ensuring data robustness. Terrain effects are addressed by an innovative and efficient multi-resolution prism-based algorithm, balancing accuracy with computational speed.

Results

The developed software enables the visualization and export of gravity data on maps, profiles, and grids.



An example is the gravimetric profile view, where all observations (from raw to corrected data) are displayed along survey lines, allowing the inspection team to clearly identify local anomalies.









DISCLAIMER

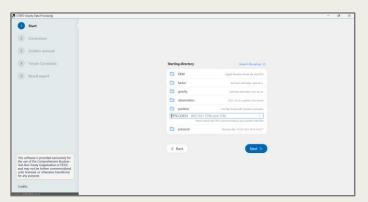


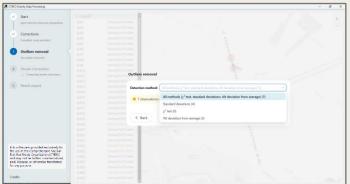


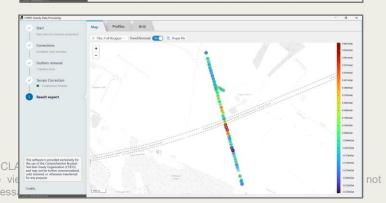
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Additional material

