Title: Analysis of non-stationary components of the gravity field using Hybrid Gravimetry in the Campi Flegrei area

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Co-tutor: Carlino S.

Research program

It is proposed to develop a PhD project aimed at monitoring mass redistribution processes at depth in the Campi Flegrei volcanic area using innovative gravimetric techniques. The state of the art testifies that the integrated use of absolute and relative gravimeters, in permanent recording and in transient acquisition, allows a higher spatio-temporal resolution power in the detection of non-stationary components of the gravity field (Portier et al., 2018; Crossley et al. 2013). The chosen target area will be the Solfatara-Pisciarelli region, located in the central area of the Campi Flegrei caldera, where the most intense dynamics are observed at present. This methodology will necessarily have to integrate the monitoring of ground deformations, in order to resolve the elasto-gravitational variations associated with the volcanic phenomena underway and to be able to separate the deformation contribution from the 'Newtonian' one. In addition to analytical evaluations of the data collected, finite element modelling (FEM) of the mass redistribution phenomena will be attempted and validated using the collected observations.
The project will be developed and directed in synergy with two Functional Units (UF2 "Geophysical Monitoring" and UF3 "Satellite Geodetic Observations") of the Osservatorio Vesuviano, Naples section of the INGV and will make use of relative and absolute gravimeters (ballistic and atomic) and a relative gravimeter specifically designed for permanent recordings. The gravimeters in permanent configuration will allow maximum time resolution at selected points, while the repeated measurement of the network with relative and absolute gravimeters will allow reconstruction of the range of variations. Geodetic data (GNSS and tide gauge) from the NeVoCGPS network and InSAR data will also be analysed for the study of ground deformations. The gravity variations detected will be interpreted in the light of the gravimetric and geodetic data collected in the area as part of the monitoring programmes implemented by INGV for several decades.

Time plan
1st Year: Bibliographic research and study of the theoretical foundations of gravimetric signal analysis. Use of softwares for processing gravity records as well as data acquired on networks.
2nd Year: Data analysis; 4-month internship abroad (GFZ Potsdam or School of Earth Sciences University of Bristol) to study advanced techniques for gravimetric data analysis and FEM modelling. Attendance of international conferences, writing peer-reviewed articles.
3rd Year: Interpretation of results; Presentation of results at International Conferences and in peer-reviewed articles. PhD writing.

Proposal for a PhD position
MUR

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References

Crossley D., Hinderer J., Riccardi U. (2013). The Measurement of Surface Gravity. Reports on Progress in Physics, 76: 046101 (47 pp). doi: 10.1088/0034-4485/76/4/046101.

Portier N., Hinderer J., Riccardi U., Ferhat G., Calvo M., Abdelfettah, Y., Heimlich C., Bernard, J.-D. (2018). "Hybrid gravimetry monitoring of Soultz-sous-Forêts and Rittershoffen geothermal sites (Alsace, France)". Geothermics 76, 201-219. DOI: 10.1016/j.geothermics.2018.07.008.