University of Genova

Department of Earth, Environmental and Life Sciences

Doctorate Course in Earth and Environmental Science and Technology

Earth Science Curriculum

Università degli Studi di Genova

STAT

Dottorato in Scienze e Tecnologie per l'Ambiente e il Territorio

Research Theme n. 3

Titolo: Monitoraggio multi-parametrico del processo sismogenetico: definizione di precursori sismici e loro applicazione nell'ambito della previsione dei terremoti.

Title: Multi-parametric monitoring of the seismogenic process: definition of seismic precursors and their application in the field of earthquake forecasting.

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Program description:

Earthquake prediction still represents one of the most ambitious challenges for the scientific community. Although there is still no way to predict a major earthquake, observational methods (e.g. near-fault observatories, multi-parametric monitoring) and mathematical techniques (e.g. multi-hazard analysis, machine learning) are constantly evolving in order to break the barrier that separates man from earthquake prediction. In this context, multi-parametric approaches allow a better understanding of complex, non-stationary systems, such as the seismic process. Thus, at least in principle, they are potentially more effective than approaches based on the analysis of single parameters in providing earthquake forecasts or warnings, which can be useful to public organizations within the framework of operational decision-making. Recently, the National Institute of Geophysics and Volcanology (INGV) released MUDA (geophysical and geochemical MUltiparametric Database), a new infrastructure for the dissemination of geophysical and geochemical data acquired in real time. The objective of this infrastructure is to allow scientists to study correlations between seismic events and variations in environmental parameters (e.g. level and conductivity of groundwater; flow of carbon dioxide), some of which are also of paramount importance in relation to climate change. The present proposal fits into this field of research. On the one hand, it aims at investigating the predictive power of environmental parameters (interpreted as earthquake precursors), possibly including proxies of different nature (e.g. deformation from GNSS and InSAR monitoring). On the other hand, it aims at developing new techniques for earthquake forecasting (or earthquake warning) that incorporate the information associated with multi-parametric data. To this end, the use of modern machine learning algorithms might prove invaluable. The final goal is to obtain a tool that can guide operational decision-making processes for seismic risk mitigation purposes.

Activities within the framework of the program will be mainly carried out at DISTAV – Università degli Studi di Genova with the support of INGV and Università degli Studi di Milano Bicocca (prof. Andrea Luca Rizzo). A 3-month period abroad at a European research organization is envisaged (e.g., University of Clermont-Auvergne)
Financial support: possibility of financial support up to approximately € 25.000
1) Barani S., L. Cristofaro, M. Taroni, L. A. Gil-Alaña, G. Ferretti (2021). “Long memory in earthquake time series: the case study of the geysers geothermal field”, Frontiers in Earth Science, doi: 10.3389/feart.2021.563649. 2) Barani S., C. Mascandola, E. Riccomagno, D. Spallarossa, D. Albarello, G. Ferretti, D. Scafidi, P. Augliera, M. Massa (2018). “Long-range dependence in earthquake-moment release and implications for earthquake occurrence probability”, Scientific Reports 8:5326. 3) Barani S., C. Mascandola, E. Serpelloni, G. Ferretti, M. Massa, D. Spallarossa (2017). “Time-Space evolution of seismic strain release in the area shocked by the August 24-October 30 Central Italy Seismic Sequence”, Pure and Applied Geophysics, Vol. 174, 1875-1887.