



DIPARTIMENTO DI STRUTTURE PER L'INGEGNERIA E L'ARCHITETTURA
CORSO DI DOTTORATO DI RICERCA IN
INGEGNERIA STRUTTURALE GEOTECNICA E RISCHIO SISMICO

XXXIX CICLO

I sottoscritti prof.ssa **Marianna Pirone** (PO ☐ PA ☒ RU ☐ RTD ☐)

prof. **Antonio Santo** (PO ☐ PA ☒ RU ☐ RTD ☐)

affidenti al Dipartimento di Ingegneria Civile Edile Ambientale

(S.S.D. ICAR/07-Prof. Pirone e GEO/05 -Prof. Santo)

CHIEDONO

di essere inseriti tra i possibili tutor di studenti di dottorato per il XXXIX ciclo.

1. Curriculum sintetico del proponente (max 500 parole)

Prof.ssa **Marianna Pirone**

Academic career:

From January 2023: Associate Professor in Geotechnical Engineering at 'University of Naples Federico II', Department of Civil, Architectural and Environmental Engineering (D.I.C.E.A.).

20/1/2020-20/1/2023: Research Fellow in Geotechnical Engineering, (Ricercatore a tempo determinato b), RTDb) Department of Civil, Architectural and Environmental Engineering of the University of Naples "Federico II".

30/12/2016-19/1/2020: Research Fellow in Geotechnical Engineering, (Ricercatore a tempo determinato a), RTDa) Department of Civil, Architectural and Environmental Engineering of the University of Naples "Federico II".

1/12/2015-30/11/2016: Research Assistant for 1 Year in Geotechnical Engineering Department of Civil, Architectural and Environmental Engineering of the University of Naples "Federico II".

1/3/2011-1/5/2013: Research Assistant for 2 Year in Geotechnical Engineering, Department of Civil, Architectural and Environmental Engineering of the University of Naples "Federico II".

1/11/2009-31/12/2010: Research contractor for the European project 'Safeland'.

2010: PhD in Geotechnical Engineering. University of Naples "Federico II",



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Thesis "Analysis of slope failure mechanism in unsaturated pyroclastic soils, based on testing site monitoring".

Teaching activities:

From 2020 to date: Geotecnica (Fundamental of Geotechnics) (72 h) Institutional Courses at University of Naples 'Federico II'.

From 2021 to date: Laboratorio di calcolo (Calculation laboratory) (24h) Institutional Courses at University of Naples 'Federico II'.

From 2017 to 2019: Fondazioni I (Foundation) (48 h) Institutional Courses at University of Naples 'Federico II'.

2019: Slope stability (72 h) Institutional Courses at University of Naples 'Federico II'

12-16 June 2017: Short course (16h) 'Slope Stability in Partially Saturated Slope' PhD course at University of Strathclyde.

February 2018-June 2022: Short course (18 h) 'Opere di sostegno per la stabilità dei pendii' (Analysis and Design of slope-stabilising piles) PhD course for Structural Engineering, Geotechnics and Seismic Risk, University of Naples Federico II

April 2018-April 2020-April 2022: Lessons (10h) 'Implementazione di modelli costitutivi nel codice di calcolo numerico PLAXIS', II level Master 'Geotecnica per le Infrastrutture' at University of Naples 'Federico II'.

Research themes:

- Hydro-mechanical behaviour of soils in unsaturated conditions
- Modelling of unsaturated and saturated soil slope and earth embankment
- In situ monitoring, measurements and analyses
- Triggering mechanisms of shallow landslides
- Prototype development
- Analysis and design of slope stabilising piles
- Analysis and design of drainage for slope stabilization

Research project:

from 2023: Principal Investigator PI of project 'Integrated apPROach for MITigation of flowSlidE risk: full scale test and advanced numerical modelling' (**PROMISE**), **PRIN Bando 2022**, Prot. 2022KL5792.

2019-2021: Principal Investigator PI of project '**TEMPO**': 'New technologies for in time prediction of flowslide occurrence'. Funded by **STAR 2018** (Sostegno Territoriale alle Attività di Ricerca, Compagnia San Paolo).

2020 to date: Participation to project '**MITIGO**': Mitigazione dei rischi naturali per la sicurezza e la mobilità nelle aree montane del Mezzogiorno FESR, **PON** Ricerca e Innovazione 2014-2020 (ARS01_00964).

2018-2021: Participation to project '**GRISIS**': 'Gestione dei rischi e sicurezza delle infrastrutture a scala regionale' **POR** Campania, FESR 2014-2020. CUP B63D18000280007.



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2013-2017: Participation to project '**METROPOLIS**': 'Metodologie e Tecnologie integrate e sostenibili per l'adattamento e la sicurezza dei sistemi urbani' **PON 03PE_00093_4**.

2017-2020: Participation to Italian project **PRIN 2015**, 'Innovative monitoring and design strategies for sustainable landslide risk mitigation', PRIN, 2015.

2015-2019: Participation to European project, **TERRE** 'Training Engineers and Researchers to Rethink geotechnical Engineering for a low carbon future' **2020-MSCA-ITN-2014, N° 675762**.

Prof. Antonio Santo

Academic career:

2006 to date: Associate Professor of Engineering Geology since 2006 at University of Naples Federico II.

2001- 2003: Researcher of Engineering Geology at University of Naples Federico II.

1990-2001: Technician in Applied Geology at University of Naples Federico II.

1998-1999: Consultant of CNR - GNDICI (Gruppo Nazionale Difesa Catastrofi Idrogeologiche).

1999-2000: Consultant of C.U.G.R.I. (Inter - University Consortium for Great Risks forecast and prevention).

2001-2003: Consultant of Regione Campania, "Sinistra Sele" Regional Authority

2006: Consultant of Regione Campania, "Sarno river" Regional Authority

2007-2008: Consultant of Hydrogeological risk planning Government Commissary–Landslide risk mitigation in the Sarno municipality.

Teaching activities:

Since 2012 to date: Geologia applicata, institutional course at University of Naples Federico II.

Since 2012 to date: Rischi geologici nella progettazione di opere di ingegneria civile, institutional course at University of Naples Federico II.

2001-2006: Geologia applicata, as contract teacher at University of Naples Federico II.

Research themes:

- Engineering geology
- slope stability
- flow-slides
- landslide susceptibility evaluation and mapping
- slope instability in karst areas
- sinkholes and alluvial fan flooding



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Research projects:

2009-2012: Scientific Coordinator of Operative Unit, RS2 Task 2.1, 2.2 "Definition of geological models and site amplification for impulsive earthquakes near-source". Project "**RELUIS**" (Rete dei laboratori Universitari di Ingegneria Sismica) funded by Dipartimento di Protezione Civile.

2014-2017: Scientific Coordinator of OR2, **PON** 03PE 00093-4 **METROPOLIS** - Metodologie e Tecnologie Integrate e Sostenibili per l'Adattamento e la Sicurezza di Sistemi Urbani.

2014-2018: Scientific Coordinator of WP4 -Approcci a larga scala per la Previsione della risposta locale e dell'instabilità del sottosuolo. Project **RELUIS** 2014-2018 (Rete dei Laboratori Universitari di Ingegneria Sismica).

2018-2020: Scientific Coordinator of project **POR** "Gestione dei Rischi e Sicurezza delle Infrastrutture a Scala Regionale (**GRISIS**)".

2019-2021: Scientific Coordinator of **RELUIS**- WP16, Ingegneria Geotecnica, Task 16.2 – Stabilità dei pendii. Dipartimento Protezione Civile.

2022 – 2024: Participation to project **PON-MITIGO** (Mitigazione dei rischi naturali per la sicurezza e la mobilità nelle aree montane del mezzogiorno). FESR, PON Ricerca e Innovazione 2014-2020 (ARS01_ 00964).

2022-2024: Scientific Coordinator of **RELUIS**-WP16, Ingegneria Geotecnica, Task 16.2 – Stabilità dei pendii. Dipartimento Protezione Civile.

2. Dottorandi dei quali il proponente è stato tutor nell'ultimo triennio

<i>Prof.ssa Pirone</i> n. 2	• Assistant supervisor of the PhD thesis of <i>Ana Sofia Dias</i>, within the European project 'TERRE' 'Training Engineers and Researchers to Rethink geotechnical Engineering for a low carbon future' 2020-MSCA-ITN-2014. Dottorato di ricerca in Ingegneria strutturale, geotecnica e rischio sismico, XXXI ciclo, Università degli Studi di Napoli, Federico II. Thesis: The effect of vegetation on slope stability of shallow pyroclastic soil covers. • Assistant supervisor of the PhD thesis of <i>Mariialaura Tartaglia</i>, Dottorato di ricerca in Ingegneria strutturale, geotecnica e rischio sismico, XXXIV ciclo, Università degli Studi di Napoli, Federico II. Thesis: Triggering of meteo-induced flow-like landslides in unsaturated pyroclastic soil: Pozzano and Pimonte case histories (Campania region).
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<i>Prof. Santo</i> <i>n.1</i>	Co-tutor of the PhD thesis of <i>Francesco Gargiulo</i>, Dottorato di ricerca in Ingegneria strutturale, geotecnica e rischio sismico, XXXV ciclo, Università degli Studi di Napoli, Federico II. Thesis: Multi-level analysis of seismic ground instability in the volcanic island of Ischia (Italy).
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3. Titolo della ricerca proposta

Integrated approach for mitigation of flowslide risk.

4. Area tematica

Ingegneria Geotecnica ☒

Ingegneria Strutturale ☐

Rischio Sismico ☐

5. Tipologia di borsa per la quale si propone il progetto

Ateneo ☒

DM 117 (Investimento 3.3) ☐
(in questo caso indicare l'azienda co-finanziatrice)

DM 118 (Investimento 4.1 P.A.) ☒

DM 118 (Investimento 4.1 generici) ☐

DM 118 (Investimento 4.1 Patrimonio culturale) ☐



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6. Sintesi del progetto di ricerca (max 500 parole. Stato dell'arte, obiettivi e breve programma previsto per le attività e)

Flowslides are tragically known worldwide for posing a threat to human life and causing heavy damages to structures and infrastructures. They are often observed on slopes formed of partially saturated soils and are generally triggered by intense rainfalls that cause a matric suction decrease and a consequent soil shear strength reduction.

In the last decades, low matric suctions and high volumetric water contents were identified as key flowslide predisposing factors. Consequently, in situ monitoring has become an essential tool for setting up reliable alarm systems. Despite a clearer identification of key predisposing factors, the interpretation of flowslides still remains challenging. In fact, more extensive and detailed analyses are required to quantify how much local factors like stratigraphy, topography, buried morphology, and vegetation contribute to flowslide initiation.

Due to the limitations highlighted, current flowslide risk mitigation strategies mainly consist of rainfall thresholds derived from empirical and statistical approaches that do not account for the hydro-mechanical slope behavior and the local factors. Therefore, more reliable flowslide predictions and associated alarm systems could be obtained only by means of physically-based predictive approaches that account for all the key factors influencing the flowslide trigger. Physically-based rainfall thresholds based on an innovative and more reliable procedure for flowslide prediction could benefit from the *integration between **in situ monitoring*** of soil variables recognized as predisposing factors and **advanced numerical modelling**.

The project covers this topic and deals with an **integrated approach** that can be developed with reference to an area belonging to the Lattari Mountains (Campania Region, Italy), historically affected by several high-risk flowslides. In particular, this research intends to cover the activities related with the in situ-monitoring.

A 'reference test site' will be instrumented for in situ monitoring of hydraulic and mechanical soil variables, to track the slope behavior under weather conditions. Then, at the same site, a small zone will be safely isolated and tested under an artificial, critical rainfall event, to explore the triggering mechanism and, finally, to identify more reliable rainfall thresholds. The area chosen for the monitoring and the full-scale test under critical artificial rainfall has been already identified, and the permission to proceed with the activities is granted by means of an agreement stipulated between DICEA, the Civil Engineering Department of the Salerno province (Genio Civile di Salerno) and the owner of the quarry (ITALSUD Srl).

Therefore, the planned research activities can be divided in three parts, these are:

- geotechnical/geological characterization of the soil sampled at the area chosen for field monitoring;



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- instrumentation of a 'reference test site' for collecting hydraulic and mechanical soil variables under weather conditions;
- design and execution of the real-scale experiment. Artificial critical rainfall will be applied at the small area in order to cause the failure. The monitoring layout of the area will be designed to measure both the hydrological and the geo-mechanical responses of the slope.

These activities are within the project **PROMISE, PRIN 2022** coordinated by Prof. Pirone (PI) and within the **Agreement** between 'Presidio di Protezione Civile-Genio Civile di Salerno', 'ITALSUD Salerno S.r.l' and Dipartimento di Ingegneria Civile Edile Ambientale of University of Naples Federico II, coordinated by Prof. Santo and Prof. Pirone.

7. Eventuali pubblicazioni del tutor sul tema di ricerca (max 10)

- Pirone M, Di Maio R, Forte G, De Paola C, Di Marino E, Salone R, Santo A, Urciuoli G (2023). Study of the groundwater regime in unsaturated slopes prone to landslides by multidisciplinary investigations: Experimental study and numerical modelling. **Engineering Geology** Volume 315, 20 March 2023, 107045.
- Tartaglia, M., Pirone, M., Urciuoli, G.(2023) A data-driven approach to assess the role of the groundwater conditions in triggering shallow landslides initiating with frictional failure. **Landslides**, 10.1007/s10346-023-02049-z
- Dias, A.S., Pirone, M., Nicotera, M.V. et al. (2021). Hydraulic hysteresis of natural pyroclastic soils in partially saturated conditions: experimental investigation and modelling. **Acta Geotechnica** <https://doi.org/10.1007/s11440-021-01273-y>
- Dias, A.S., Pirone, M., Nicotera, M.V., Urciuoli, G. (2022). Hydraulic characterization of an unsaturated vegetated soil: The role of plant roots and hydraulic hysteresis. **Geomechanics for Energy and the Environment** 2022, Volume 30, 100235. <https://doi.org/10.1016/j.gete.2021.100235>
- Forte G., Pirone M., Santo A., Nicotera M.V., Urciuoli G. (2019). Triggering and predisposing factors for flow-like landslides in pyroclastic soils: the case study of the Lattari Mts. (southern Italy). **Engineering Geology** 257, 105137, 1-15. ISSN:0013-7952. doi.org/10.1016/j.enggeo.2019.05.014
- Pirone M., Papa R., Nicotera M.V., Urciuoli G. (2015). Soil water balance in an unsaturated pyroclastic slope for evaluation of soil hydraulic behavior and boundary conditions. ISSN: 0022-1694 **Journal of Hydrology** 528, 63-83. <http://dx.doi.org/10.1016/j.jhydrol.2015.06.005>.



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- Pirone M., Papa R., Nicotera M.V., Urciuoli G. (2015). In situ monitoring of the groundwater field in an unsaturated pyroclastic slope for slope stability evaluation. **Landslides** 12 (2), 259-276. ISSN:1612-510X (Print) 1612-5118 (Online), DOI: 10.1007/s10346-014-0483-z.
- Papa R., Pirone M., Nicotera M.V., Urciuoli G. (2013). Seasonal groundwater regime in an unsaturated pyroclastic slope. **Geotechnique**. Volume 63, Issue 5, 420-426. ISSN:00168505 <http://dx.doi.org/10.1680/geot.11.P.049>.
- Santo A., Di Crescenzo G., Forte G., Papa R., Pirone M., Urciuoli G. (2018). Flow-type landslides in pyroclastic soils on flysch bedrock in southern Italy: the Bosco de' Preti case study, **Landslides**, vol. 15, p. 63-82
- Balzano B., Tarantino A., Nicotera M.V., Forte G., De Falco M., Santo A. (2018). Building physically-based models for assessing rainfall-induced shallow landslide hazard at the catchment scale: the case study of the Sorrento Peninsula (Italy). **Canadian Geotechnical Journal**, vol. 56, p. 1291-1303.

8. Eventuali progetti di ricerca finanziati in cui l'attività si inserisce

- **PRIN 2022**, Integrated apPROach for MITigation of flowSlidE risk: full scale test and advanced numerical modelling (PROMISE), PROGETTI DI RICERCA DI RILEVANTE INTERESSE NAZIONALE – Bando 2022, Prot. 2022KL5792. PI: Marianna Pirone, University of Naples 'Federico II'
- **Agreement** between 'Presidio di Protezione Civile-Genio Civile di Salerno', 'ITALSUD Salerno S.r.l.' and Dipartimento di Ingegneria Civile Edile Ambientale of University of Naples Federico II. Object: 'Studio dei meccanismi d'innescio di colate di fango nelle coltri piroclastiche del contesto geologico e geotecnico dei Monti Lattari (Regione Campania)'

9. Eventuali fondi disponibili a supporto dell'attività del dottorando (escluso finanziamento borse)

- PRIN 2022, Integrated apPROach for MITigation of flowSlidE risk: full scale test and advanced numerical modelling (PROMISE), PROGETTI DI RICERCA DI RILEVANTE INTERESSE NAZIONALE – Bando 2022, Prot. 2022KL5792. PI: Marianna Pirone, University of Naples 'Federico II'.



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10. Informazioni relative ad un periodo di ricerca all'estero (minimo tre mesi) previsto per il dottorando (*indicare Università/ente di ricerca e docente/ricercatore di riferimento con indirizzo mail*) (max 300 parole)

The design of the *monitoring layout and the advanced geotechnical soil characterization in partially saturated conditions* can take place in collaboration with prof. Alessandro Tarantino, full professor at the University of Strathclyde, Glasgow: alessandro.tarantino@strath.ac.uk. The professor Tarantino is an expert on behavior of partially saturated soils and the operation/development of sensors for measuring field hydraulic variables in partially saturated slope as evidenced by his intense scientific production on topic (<https://www.strath.ac.uk/staff/tarantinoalessandroprof/>). In particular he is an excellent expert in suction measurement on site and in the laboratory. Collaboration with the University of Strathclyde has been well establishing for many years (since 2014) thanks to the participation of Prof.ssa Pirone in two European research projects coordinated by prof. Tarantino. The PhD student can spend 6 months at University of Strathclyde under the supervision of prof. Tarantino in order to carry out the geotechnical soil characterization at unsaturated conditions and to design the full-scale test and the monitoring layout at the slope under artificial rainfall.

11. Eventuali collaborazioni con imprese/aziende sul tema di ricerca (max 300 parole)

Napoli, 29/06/2023

FIRMA

Il presente modulo va compilato in ogni sua parte ed inviato all'indirizzo di posta elettronica phd.dist@unina.it entro e non oltre **il 30/06/2023**.