University of Milano-Bicocca
PhD Course in Chemical, Geological and Environmental Sciences
Project scholarships 39th cycle - session II

SCGA.1		**Supervisor**	**Emilio Padoa Schioppa**
Curriculum	***Terrestrial and Marine Environmental Sciences***		
Title	**Definition, measurement, and quantification of ecosystem services in urban regeneration interventions**		

Urban regeneration interventions are often based on the concepts of green infrastructure and Nature Based Solutions (NBS) and aim at reducing negative effects typical of the urban environment and at the same time improving the ecological status of the area. The aim of the project is to evaluate and quantify the ecosystem services (SE) offered by urban regeneration interventions. The evaluation will have to take place considering all aspects included in ecosystem services: ecological, social, and economic. To achieve this goal, it is proposed to define a multiscalar and transdisciplinary qualitative-quantitative analysis, identifying different contexts in which urban regeneration interventions have been designed. The candidate will have to develop a project using different methodologies, aimed at defining the different SEs (C-stock, removal of pollutants, increase in biodiversity, pollination, cultural) and also at defining their social and economic impact. For this reason, the candidate will work with different techniques, such as e-DNA, drones, LAI, thermal monitoring, measures for the collection and analysis of quantitative social and economic data, integrating the data collected in the various case studies. The priorities of digital transition and biodiversity will be guaranteed by monitoring the state of conservation of biodiversity in the areas of intervention using digital maps also obtained from the processing of the data collected.

Supervisor webpage: https://www.unimib.it/emilio-padoa-schioppa

Notes: *Borsa PNRR cofinanziata ex D.M. 118/2023*

For further details, see: https://www.unimib.it/sites/default/files/no-index/2023-06/SCGA_0.pdf

University of Milano-Bicocca
PhD Course in Chemical, Geological and Environmental Sciences
Project scholarships 39th cycle - session II

SCGA.2		**Supervisor**	**Micol Rossini**
Curriculum	***Terrestrial and Marine Environmental Sciences***		
Title	**Monitoring the health of urban ecosystems with innovative remote sensing techniques**		

Terrestrial ecosystems with their animal and vegetation biodiversity provide multiple functions for human well-being, economic and social development. In particular, the characterisation of the evolution of the functional dynamics of urban ecosystems is fundamental in order to preserve biodiversity and promote the implementation of effective and resilient Nature Based Solutions (NBS) over time, restoring or enhancing related ecosystem services. The PhD project is envisaged to develop innovative products aimed at monitoring the health of urban green areas using remote sensing techniques with a multi-scale approach. The optical properties of vegetation vary depending on its biochemical, structural, and physiological state. Integrating remote sensing techniques, field measurements and ecological modelling, the PhD student will aim to produce maps of vegetation parameters (e.g., chlorophyll content, sun-induced fluorescence) and maps of health status indicators using new drone-borne sensors and the analysis of their variations in response to anthropogenic and natural factors (e.g., drought). The results of the research will provide operational indicators to monitor the impacts of pollution and climatic extremes on urban vegetation over time and will allow NBSs for the restoration of urban environments.

Supervisor webpage: https://www.unimib.it/micol-rossini

Notes: *Borsa PNRR cofinanziata ex D.M. 118/2023*

For further details, see: https://www.unimib.it/sites/default/files/no-index/2023-06/SCGA_0.pdf

University of Milano-Bicocca
PhD Course in Chemical, Geological and Environmental Sciences
Project scholarships 39th cycle - session II

SCGA.3		**Supervisor**	**Francesco Peri**
Curriculum	***Chemical Sciences***		
Title	**Synthesis of novel human TLR4 receptor modulators**		
The research project is based on the development of new synthetic molecules capable of activating the TLR4 receptor of innate immunity. The research project is aimed at the identification of new IPs that may have a role in the treatment of rare diseases and autoimmune inflammatory diseases. The new molecules synthesized will be subject to patenting and subsequent publication. The Ph.D. student will have the opportunity to participate in international conferences and spend the planned period in a foreign research group.			
Supervisor webpage: https://www.unimib.it/francesco-peri			
Notes: *Scholarship funded by external body D.M. 117/2023 CP2 Biotech*			
For further details, see: https://www.unimib.it/sites/default/files/no-index/2023-06/SCGA_0.pdf			

University of Milano-Bicocca
PhD Course in Chemical, Geological and Environmental Sciences
Project scholarships 39th cycle - session II

SCGA.4		**Supervisor**	**Andrea Franzetti**
Curriculum	***Terrestrial and Marine Environmental Sciences***		
Title	**Reuse of Bioremediated Hydrocarbon-Contaminated Sediments as Soil for Non-Food Crops: Evaluating Properties, Ecotoxicity, Biological Safety, and Circular Economy Aspects**		

Introduction: This PhD project focuses on assessing the feasibility and sustainability of reusing hydrocarbon-contaminated sediments, treated using biological technologies, as a technosoil for cultivating non-food crops. It aims to explore various aspects, including the fertility of bioremediated sediments, their ecotoxicity, biological safety, and the implications for the circular economy. Evaluation of Fertility of Bioremediated Sediments for Non-Food Crop Cultivation: The project's primary objective is to analyze the physical, chemical and biological fertility of bioremediated sediments for the growth of non-food crops. to this end, total content and availability of primary and secondary nutrients content, physical structure, water retention capacity, and permeability will be evaluated. Laboratory analyses will also measure residual hydrocarbon levels and bioavailability of potentially toxic elements to ensure they fall within safe legislation thresholds. Ecotoxicity and Biological Safety: A critical aspect of the project involves assessing the ecotoxicity and biological safety of using bioremediated sediments as soil for non-food crops. Toxicity essays will be conducted to determine any potential adverse effects on plants growth, microorganisms, and other relevant organisms. This analysis will guarantee that the sediments pose no significant risks to the environment, or human safety. Circular Economy Considerations: The project will also investigate the circular economy implications of the use of bioremediated sediments for non-food crop cultivation. It will evaluate the economic sustainability, resource efficiency, and environmental benefits associated with this practice. By reusing the sediments, the project aims to minimize waste generation, reduce the use primary raw meaterials, and promote a sustainable and circular approach to soil management. Conclusion: This PhD project aims to provide a comprehensive evaluation of reusing bioremediated hydrocarbon-contaminated sediments as soil for non-food crops. By analyzing their properties, ecotoxicity, biological safety, and circular economy aspects, the study seeks to support the development of sustainable strategies for the sustainable recycle of contaminated sediments.
The findings will contribute to efficient resource utilization, reduced environmental impacts, and the promotion of circular economy principles in the field of sediment management.

Supervisor webpage: https://www.unimib.it/andrea-franzetti

Notes: *Scholarship funded by external body D.M. 117/2023: SISTEMI AMBIENTALI SRL*

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University of Milano-Bicocca
PhD Course in Chemical, Geological and Environmental Sciences
Project scholarships 39th cycle - session II

SCGA.5		**Supervisor**	**Cristina Flesia**
Curriculum	***Geological Sciences***		
Title	**Advanced analysis of multi-satellite data using AI tools**		

While the performance of the measurements of atmospheric parameters has reached very high accuracy, the analysis of the satellite and ground-based data deserves a more in-depth analysis. This would allow significant progress in the input of numerical atmospheric modelling, the control of climate dynamics, air pollution, transport of pollutants, agriculture, etc.. In particular, more detailed information extracted from space measurements could have a relevant impact on the large-scale atmospheric monitoring and is one of the basic pillar of the space economy. Several international data banks are available for the analysis of atmospheric data. Those precious instruments, often automatically integrated by numerical models, show limitations for an advanced and high accuracy analysis of the large and very rich information of their content. Significant limitations, dictated by the quality control on the use of data, are related to: 1.- Impossibility to compare results from different sources on the same ground area and/or time Period 2.- Difficulties to compare results with different calibrations, spatio-temporal resolutions and instrumental characteristics and to evaluate the weights of those parameters of the results. Thales Alenia Space has developed a platform (The Satellite Highly Interactive Visualizations and Analytics (SHIVA)) devoted to satellite telemetry analysis that originated from the needs to analyse the telemetry history of spacecrafts for the purpose of verifying their integrity and well-behaviour. To achieve these goals, the platform is designed with a microservices architecture based on an archive comprising InfluxDB for efficient storage and retrieval of TM parameters and MongoDB for raw TM packets, frames and ancillary information. A Data Access Layer abstracts the underlying structure and streamlines query operations. The user interaction is provided by an immediate and responsive web UI, while the interactive plotting service has been developed using Bokeh. A matplotlib-based service allows offline batch generation of charts to be included in reports and an environment for data-scientists is offered as an integrated JupyterHub server. Here we propose to test the possibilities to use an informatic instrument such SHIVA to develop a joint and advanced analysis platform of different kinds of measurements of atmosphere. Results will allow preliminary information on the gap between the present analysis of single data and a joint comparative and iterative analysis of different parameters and /or the same parameters measured by different sources with different accuracies. Testing will be concentrated over Milano and the Lombardia Region, to better answer to the objectives of MUSA.

Supervisor email: cristina.flesia@unimib.it

Notes: *Borsa PNRR/Scholarship PNRR - Centro Nazionale HPC di Ateneo CUP: H43C22000520001*

For further details, see: https://www.unimib.it/sites/default/files/no-index/2023-06/SCGA_0.pdf

University of Milano-Bicocca
PhD Course in Chemical, Geological and Environmental Sciences
Project scholarships 39th cycle - session II

SCGA.6		**Supervisor**	**Nicola Piana Agostinetti**
Curriculum	***Geological Sciences***		
Title	**The topography of the Moho discontinuity under the Alps-Apennines mountain chain, from the analysis of a state-of-the-art, multi-level Receiver Function database**		

The knowledge of the deep crust structure under the mountain chains is a key-elements to develop geodynamic models that help in understanding how such mountain chains have been developed and their present-day morphology. In general, such knowledge is based on passive seismic data (i.e. where the source of elastic wave is natural) acquired during temporary seismic experiment or by permanent seismic networks. Our knowledge of the deep crust in the Centro-Mediterranean area has increased in the last decade, however a comprehensive and updated model of the crust-mantle boundary (so called "Moho) is still lacking. Most of the recent studies about the geodynamics of the area are still based on ten-years old papers (Piana Agostinetti and Amato, 2009; Spada et al. 2013) with a strong potential for misinterpretation based on the limited number of observations available in the past, especially for the Southern Apennines. The present-day availability of a large number of new observations and the possibility of large-scale data analysis (both in terms of number of seismic stations and amount of passive seismic data) pose new challenges and can fulfil the need of a overall revision of the previous studies. Passive seismic data recorded in the Central-Mediterranean area represent an archive of information not organised in a compelling way and, thus, of difficult use for production of models of the crust useful for geodynamic modelling, both at local and regional scale. Moreover, part of this information have been collected during the last years following seismic sequences of national interest, without integrating the data-sets into permanent archives. During this study, we: (1) constitute an archive of passive seismic data for the Central-Mediterranean area, shareable as open-access, containing both raw and processed data; (2) employ such archive to compute a new Moho topography map for the region, using both "legacy" algorithms and more innovative approaches developed on purpose.

Supervisor webpage: https://www.unimib.it/nicola-piana-agostinetti

Notes: *Scholarship funded by external body ISTITUTO NAZIONALE DI GEOFISICA E VULCANOLOGIA INGV*

For further details, see: https://www.unimib.it/sites/default/files/no-index/2023-06/SCGA_0.pdf

University of Milano-Bicocca
PhD Course in Chemical, Geological and Environmental Sciences
Project scholarships 39th cycle - session II

SCGA.7		**Supervisor**	**Claudia Pasquero**
Curriculum	***Terrestrial and Marine Environmental Science***		
Title	**Intensification of tropical cyclones: impact of fine scale processes**		

The intensification of tropical cyclones has long been described as the evolution towards a maximum intensity that depends on the environmental conditions. Under this paradigm, in a homogeneous and stationary environment the intensity of the cyclone should monotonically increase. Recent high resolution numerical simulations question this view, as oscillating intensities have been obtained in modeling experiments. Although such idealized setting is not realistic, as tropical cyclones evolve along a trajectory that brings them in regions characterized by different sea surface temperatures, different tropospheric moisture content, and different upper level winds, the physical processes at the base of the obtained results need to be understood in order to improve the forecast of tropical cyclone intensity. This is of paramount importance considering that, despite the recent efforts, the community skill to predict the strength of a tropical cyclone is still quite low. Recent research also indicates that the intensification rate of hurricanes has been increasing over the last decades, with a positive contribution from anthropogenic forcing. In this project idealized numerical simulations will be run using an atmospheric non hydrostatic fine resolution model, in which convective updrafts and downdrafts will be resolved. Their characteristics will be linked to larger scale conditions as well as to feedbacks within the low pressure perturbation, including interactions with clouds and radiative effects. The role of the air-sea fluxes and of the characteristics of the marine atmospheric boundary layer will be assessed. The project, building upon High Performance Computing capabilities, is carried in the framework of the science studies in support of the ESA Earth Explorer X Mission Harmony, whose aim is the study of the fine scale characteristics at the air-sea interface with a focus on extreme weather events and will be carried with the collaboration of Prof. Caroline Muller from IST, Austria, and with OGS, Trieste.

Supervisor webpage: https://www.unimib.it/claudia-pasquero

Notes: *Scholarship co-funded by external body: OGS*

For further details, see: https://www.unimib.it/sites/default/files/no-index/2023-06/SCGA_0.pdf

University of Milano-Bicocca
PhD Course in Chemical, Geological and Environmental Sciences
Project scholarships 39th cycle - session II

SCGA.8		**Supervisor**	**Heiko Lange**
Curriculum	***Chemical Sciences***		
Title	**Experimental activities and study of the conversion processes of waste materials into catalysts for hydrogen production**		

Based on preliminary results, it seems possible to adjust the formation conditions of biochar from thermochemical processes of lignin and mixtures of lignin and non-recyclable plastics in such a way as to produce materials that are not completely depleted of the typical functional groups of lignin, particularly in terms of oxygen-containing functionalities, and that can therefore be appropriately modified for the production of higher value-added products. The aim of this doctoral project is to optimize the formation of a 'reactive' biochar, which will serve as a starting material for the synthesis of advanced materials to be used in catalytic and electrochemical fields. With respect to the development of catalysts, the goal is to develop a solid support through pyrolysis processes of lignin and waste plastics at temperatures not exceeding 600 °C with rapid heating, in order to bind metallic catalysts and/or their precursors and obtain a thermally stable and appropriately doped redox matrix. The catalysts produced via this strategy are expected to have significant applications in biomass gasification processes for hydrogen production. Similarly, through thermochemical processes at higher temperatures, efforts will be made to functionalize the obtained biochar for its use as electrode material in electrolytic cells for hydrogen production. During the course of the doctoral program, various advanced analytical techniques will be used to characterize the functionalized biochar obtained. Qualitative and quantitative analyses will also be conducted to determine the analytes formed during the studied thermochemical processes. This will contribute to a thorough understanding of the chemical and structural properties of the material and to the optimization of synthesis conditions.

Supervisor webpage: https://www.unimib.it/heiko-lange

Notes: *Scholarship funded by external body: ENEA*

For further details, see: https://www.unimib.it/sites/default/files/no-index/2023-06/SCGA_0.pdf

University of Milano-Bicocca
PhD Course in Chemical, Geological and Environmental Sciences
Project scholarships 39th cycle - session II

SCGA.9		**Supervisor**	**Sandra Citterio**
Curriculum	***Terrestrial and Marine Environmental Science***		
Title	**Production and chemical functionalization of biochar for environmental applications**		

The proposed project is in the frame of the Join Research Agreement between ENI and University of Milano Bicocca and aims at developing new products to be applied in bioremediation of soil contaminated by hydrocarbons. Bioremediation technologies exploit the ability of natural microorganisms to efficiently remove organic pollutants. Biochar is a co-product of biomass pyrolysis. It is in fact a biological material produced in the absence of oxygen, at temperatures below 700 ° C, to generate more permeable, less dense and carbon-rich products. The presence of pores, the high surface area, the ability to bind and retain nutrients (N and P) as well as organic pollutants, make biochar a good support for persistence and microbial growth (bacteria and fungi), to be applied as a soil improver to maintain and increase the physical, chemical and biological properties/ activities of the soil. Recently, it has been suggested that applying biochar to contaminated soil helps plant-microorganism systems reduce hydrocarbon concentrations. Indeed, plant-microorganism interaction can support the enzymatic ability of bacteria and fungi to degrade hydrocarbons. The aim of the project is to develop and validate a microbiologically activated biochar (Microbe-activated-Biochar (MaB), to be applied to the biological treatment of soils contaminated by hydrocarbons. The planned activity for this project are: A) production of biochar from biomass through pyrolysis, followed by physical and chemical characterization of the biochar (proportion between the pyrolysis product and the original biomass, absorption capacity, specific surface, porosity, composition, etc.); B) functional activation of biochar in order to increase its chemical and biochemical compatibility with the strains of selected microorganisms. Functional modification of the biochar can be performed through physical or chemical activation; C) the effectiveness of the MaB obtained in WP3 will be evaluated in the bioremediation of soils contaminated by hydrocarbons by laboratory tests and pilot experiments in the field.

Supervisor webpage: https://www.unimib.it/sandra-citterio

Notes: *Department Scholarship*

For further details, see: https://www.unimib.it/sites/default/files/no-index/2023-06/SCGA_0.pdf

University of Milano-Bicocca
PhD Course in Chemical, Geological and Environmental Sciences
Project scholarships 39th cycle - session II

SCGA.10		**Supervisor**	**Giovanni Crosta**
Curriculum	***Geological Sciences***		
Title	**Permeation grouting: an experimental and numerical study to improve its efficiency**		

This research deals with the study of the permeation grouting technique and the effect of injections on the mechanical and permeability characteristics of the treated soil. This is a consolidation technique in which soil is injected with consolidating mixtures that permeate the voids between soil particles. The mixtures used can be of various types depending on particle size, porosity and permeability of the soil, but also on the environmental impact related to their use. In any case, injection is always carried out by means of a valved tube (or TAM: Tube with manchéttes), isolating each valve and injecting it through a double packer. Objective: -The goal of this research is to improve efficiency by studying the permeation ofdifferent consolidating mixtures, type of soil and boundary conditions. The post-treatment characteristics will be evaluated by the use of X-ray microtomographicanalysis to study the relationships between mixture and grains and thus define howthe mixture permeates the voids, modifying porosity and permeability of thesample. In addition standard geomechanical tests will be performed.Method:1.Realization of a machine that allows 3D laboratory injection with soil confinementto reproduce in situ soil conditions at a small scale.2.Extensive experimental campaign to evaluate key variable of permeationgrouting. Two different types of tests are then carried out: 1D injections and 3Dinjections. The former are useful for studying the injection process and evaluatingthe injectability of a soil, including the type of mixture. The latter extend the conceptof one-dimensional injection and allow observation of the progress of the mixturein the soil in all directions. From both tests, once the curing time has elapsed,specimens can be obtained for mechanical testing.3.Extensive image analyses by microCT to deeply understand injection process.4.Theoretical and numerical analyses to improve the efficiency of the process.

Starting professional classification: level 5th target occupational classification: level 3 number of hours per week: 40 hours gross annual salary level 5th: €21,663.74 divided by 14 monthly salaries net monthly salary: 1,300.00 for 14 monthly payments

Supervisor webpage: https://www.unimib.it/giovanni-crosta

Notes: *High level training apprenticeship contract: Groutfreezlab s.r.l.*

For further details, see: https://www.unimib.it/sites/default/files/no-index/2023-06/SCGA_0.pdf

University of Milano-Bicocca
PhD Course in Chemical, Geological and Environmental Sciences
Project scholarships 39th cycle - session II

SCGA.11		**Supervisor**	**Andrea Franzetti**
Curriculum	***Terrestrial and Marine Environmental Science***		
Title	**Groundwater remediation: new biological and molecular strategies**		

Groundwater contamination is a worldwide problem that has a significant impact on human health and socioeconomic development, and it can also endanger environment and its ecological services. Groundwater is the major source of freshwater and represents a crucial and essential resource for the planet since it is used for domestic, agricultural, and industrial purposes (Li, 2021). Due to the wide use of petroleum hydrocarbons for industrial development during the last century, these contaminants have significantly contributed to the pollution of aquatic environments with numerous and disastrous consequences on the ecosystems of this environmental matrix. Among treatment methods for groundwater remediation, one of the most commonly used technology is to pump out contaminated water and to treat "on site" (Pump&Treat) or "off-site" (Pump&Stock). However, these methods are cost-expensive and energy-demanding; instead, the application of phytotechnologies, which are based on the use of plants and microorganisms, could bea promising alternative to remediate petroleum hydrocarbons- contaminated groundwater, because they are environmentally-friendly and potentially more cost effective than the traditional ones (Abdullah, 2020). Therefore, the first objective of the project is to investigate the possibility to treat the pumped contaminated groundwater by means of these biological technologies instead of using physico- chemical methods. Moreover, for a thorough understanding of subsurface flowpaths and fluid migration in contaminated aquifers, DNA (deoxyribonucleic acid)-Based Tracers can be developed and used, in addition to traditional tracer method, to gain insight into the autochthonous microbial community (Zhang, 2022). Thus, the second objective of the project is to develop and test synthetic DNA tracer methods in contaminated aquifers to characterize and study the dynamics and metabolic activity of microorganisms in groundwater.
Starting occupational classification: tertiary sector level 4 target occupational classification: tertiary sector level 3 number of hours per week: 40 Tertiary sector level 4 and 3 apprentice salary Level 4: direct monthly salary € 1.618.75; full monthly salary: € 1,903.94 Level 3: direct monthly wage € 1.793.11; full monthly wage: € 2,109.03

Supervisor webpage: https://www.unimib.it/andrea-franzetti

Notes: *High level training apprenticeship contract: M3R-Monitoring and Management of Microbial Resources s.r.l.*

For further details, see: https://www.unimib.it/sites/default/files/no-index/2023-06/SCGA_0.pdf