



IUSS

Scuola Universitaria Superiore Pavia

Decreto Rettoriale n. */2022

*n. della registrazione di protocollo riportato nei metadati del sistema di protocollo informatico Titulus

Oggetto:

Concorso pubblico, per titoli ed esami, per l'ammissione al Corso di dottorato di ricerca in Sustainable Development and Climate change – XXXVIII ciclo – A.A. 2022-2023 – RIAPERTURA BANDO

Pubblicato all'Albo della Scuola

Area: Area Didattica, Qualità e Servizi agli allievi

IL RETTORE

- VISTO** il Decreto ministeriale 29 dicembre 2021, n. 226 "Regolamento recante modalità di accreditamento delle sedi e dei corsi di dottorato e criteri per la istituzione dei corsi di dottorato da parte degli enti accreditati";
- VISTO** lo Statuto della Scuola Universitaria Superiore IUSS;
- VISTO** il Regolamento per i corsi di dottorato della Scuola;
- VISTO** il Regolamento del Corso di dottorato in Sustainable Development and Climate change;
- RICHIAMATO** il Decreto rettoriale n. 154/2022 del 6 luglio 2022, con il quale è stato indetto il concorso pubblico, per titoli ed esami, ai fini dell'ammissione ai corsi di dottorato di ricerca dello IUSS tra cui il dottorato in Sustainable Development and Climate change – XXXVIII ciclo;
- RICHIAMATO** il Decreto rettoriale n. 265/2022 del 7 ottobre 2022 con cui sono stati approvati gli atti del concorso per l'ammissione al dottorato di ricerca in Sustainable Development and Climate change - XXXVIII ciclo e la graduatoria generale di merito;
- RICHIAMATO** il Decreto rettoriale n. 285/2022 del 18 ottobre 2022 con il quale è stato aperto l'avviso per manifestazione di interesse per le borse non assegnate a seguito di scorrimento della graduatoria;
- RICHIAMATO** il Decreto rettoriale n. 301/2022 del 26 ottobre 2022 di approvazione degli atti relativi all' avviso per manifestazione di interesse per le borse non assegnate a seguito dello scorrimento della graduatoria relative al dottorato di ricerca in Sustainable Development and Climate change - XXXVIII ciclo e assegnazione borse;
- CONSIDERATI** la convenzione stipulata tra la Scuola IUSS e l'Università degli studi di Sassari e il relativo Addendum finalizzati all'attivazione e al

funzionamento del corso di Dottorato Nazionale in Sustainable Development and Climate change - ciclo XXXVIII;

CONSIDERATA

la convenzione stipulata tra la Scuola IUSS e l'Università degli studi di Messina finalizzata all'attivazione e al funzionamento del corso di Dottorato Nazionale in Sustainable Development and Climate change - ciclo XXXVIII e nelle more della sottoscrizione del relativo Addendum;

CONSIDERATA

la convenzione stipulata tra la Scuola IUSS e l'Università degli studi di Torino finalizzata all'attivazione e al funzionamento del corso di Dottorato Nazionale in Sustainable Development and Climate change - ciclo XXXVIII e nelle more della sottoscrizione del relativo Addendum;

CONSIDERATA

la comunicazione pervenuta da parte dell'Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile (ENEA), n. 7896 del 27/10/2022, di disponibilità al finanziamento di n. 1 borsa di studio nell'ambito del Dottorato Nazionale in Sustainable Development and Climate change - ciclo XXXVIII;

RITENUTO

di dover provvedere alla riapertura del bando di Concorso pubblico, per titoli ed esami, per l'ammissione al Corso di dottorato di ricerca in Sustainable Development and Climate change – XXXVIII ciclo – A.A. 2022-2023 con sede amministrativa presso la Scuola universitaria superiore IUSS;

DECRETA

Art. 1 - È riaperto il Bando di concorso per l'ammissione al Corso di Dottorato Nazionale in Sustainable Development and Climate change - XXXVIII ciclo - A.A. 2022/2023, con sede amministrativa presso la Scuola universitaria superiore IUSS.

Le borse di studio messe a bando sono n. 13, come riportato nell'allegato "Research Programme", facente parte integrante del presente atto.

Art. 2 - La domanda di ammissione al concorso deve essere presentata esclusivamente *on line* tramite la [piattaforma ESSE3](#) entro **le ore 16:00 CET del 14 novembre 2022**.

I candidati e le candidate che hanno già presentato domanda per una o più borse bandite con decreto rettorale 154/2022, possono candidarsi esclusivamente per le seguenti borse: CU1.24, CU2.21, CU2.25, CU3.36, CU5.19, CU6.18.

Art 3 - Gli esiti della valutazione dei titoli saranno pubblicati entro il **21 novembre 2022** all'Albo della Scuola – Sezione Bandi e concorsi.

I colloqui si svolgeranno a partire dal giorno **23 novembre 2022**. Le modalità di svolgimento della prova orale saranno comunicate ai candidati interessati con congruo preavviso.

Al termine dei colloqui ed entro il **30 novembre 2022**, sarà emanato un decreto di approvazione atti contenente la graduatoria finale formulata per curriculum, che sarà consultabile sul sito istituzionale della Scuola – Sezione Bandi e concorsi.

L'assegnazione delle borse è effettuata secondo il procedimento indicato all'articolo 6 del bando di concorso.

La procedura prosegue fino all'assegnazione di tutte le borse e si concluderà entro la data del **14 dicembre 2022**.

Art 4 – Il corso ha inizio il **15 dicembre 2022**.

Pavia, data del protocollo

IL RETTORE

Prof. Riccardo Pietrabissa

(Documento firmato digitalmente ai sensi del D.Lgs 82/2005)



Research Programme

38° cycle – Academic Years 2022/2023 – 2024/2025

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PhD SDC
SUSTAINABLE DEVELOPMENT
AND CLIMATE CHANGE



Curriculum: 1. Earth System and Environment

Addressing integrated and environmentally sustainable water resources Management (ISWRM) In the Mediterranean area

Reference Person: Bonaccorso Brunella (bbonaccorso@unime.it)

Host University/Institute: University of Messina

Research Keywords: Water resources management

Climate and land use changes

Environmental sustainability

Reference ERCs: PE10_17 Hydrology, hydrogeology, engineering and environmental geology, water and soil pollution

PE8_3 Civil engineering, architecture, offshore construction, lightweight construction, geotechnics

SH7_8 Land use and planning

Reference SDGs: GOAL 6: Clean Water and Sanitation, GOAL 11: Sustainable Cities and Communities, GOAL 13: Climate Action

Description of the research topic

The Mediterranean region is experiencing a broad range of threats to water security related to the reduction of water resources availability mainly driven by water overexploitation and pollution and land degradation, due to the rising urbanization, mass tourism and intensive farming. Excessive abstraction of water (e.G., pumping from rivers and groundwater withdrawal) is already altering natural flows, affecting downstream uses, and triggering a sequence of negative environmental impacts. On the other hand, improper land use (e.G., poor cultivation methods, deforestation, and overgrazing) is increasing soil erosion, sedimentation of reservoirs and irrigation canals, and damaging water supply infrastructures. Furthermore, climate change is expected to exacerbate the existing water scarcity issue in the region, leading to unprecedented challenges and risks, especially in arid and semi-arid regions. To address such emerging threats, effective implementation of integrated and environmentally sustainable use of surface water and groundwater resources at the river basin level, also including land use management as an integral part of sustainable water management, is of primary importance in the Mediterranean area. To this end, this research project aims at developing a holistic and dynamic approach integrating biophysical models, current and future scenarios of climate and water demand, as well as land use, to identify optimal water resources management options under different conditions in a representative water supply system in the Mediterranean region. In particular, the Ph.D.



Candidate will develop and implement a dynamic modeling framework for simulating the impact of climate and land use change, and related land and water management practices, on water resources and ecosystem services in a selected case study. The requirement for environmental flows to maintain ecosystems, such as wetland and in-stream environments, will be also considered in the modeling framework to redefine sustainable rules of competition for water and land use between the economic sectors and the environment. As a result, the modeling framework will provide all the required climate information and updated patterns of surface water availability and groundwater recharge, thus helping decision makers to adapt water use and regulation of natural and artificial water bodies, as well as land/agricultural practices, to changing climate and socio-economic conditions, always complying with environmental needs.

Research team and environment

The research activity will be carried out at the Department of Engineering, University of Messina. Within the Research Group of Water Engineering and Hydrology coordinated by Prof. Giuseppe T. Aronica. The Group includes an Associate Professor and other members (Ph.D. Students, Post-Docs, and Research Assistants) and covers research topics related to water resources management, stochastic hydrology applied to the analysis of extreme hydrometeorological events, drought and flood risk management, hydrological and hydraulic river basin modeling, among others. The Research Group collaborates with several other research groups in Italy (University of Palermo, University of Catania, IUSS Pavia, Polytechnic Milan, University of Naples, and others) and abroad (University of Exeter, University of Thessaloniki, University of Bristol, Middlesex University, University of Sarajevo and others).

Suggested skills for this research topic

The Ph.D. Candidate should have a background in civil/environmental engineering, earth and environmental sciences, or related disciplines. A solid background in mathematics, statistics and data analysis is recommended. In addition, programming skills (e.G., MATLAB, R project, Python), GIS knowledge, and experience in re-analysis, climate model and remote sensing data retrieval and elaboration will be positively evaluated. A willingness for international mobility is also recommended, as well as an attitude to work in a collaborative environment, with an interdisciplinary approach.



Curriculum: 2. Socio-Economic Risk and Impacts

Developing innovative approaches for cascading effects to improve flood risk management actions with a specific interest on the functional vulnerability of critical infrastructures.

Reference Person: Aronica Giuseppe Tito (giuseppetito.aronica@unime.it)

Host University/Institute: University of Messina

Research Keywords: Resilience and risk impact

Critical infrastructures

Sustainable engineering

Reference ERCs: PE8_3

SH7_6

PE8_11

Reference SDGs: GOAL 11: Sustainable Cities and Communities, GOAL 13: Climate Action

Description of the research topic

Risk analysis is central to Civil Protection activities and is the core element of risk management. Specific "Risk Management Plans" are needed to ready Civil Protection structures for tackling and managing an emergency. These identify the objectives that must be followed and achieved for the organisation of a desirable response by the Civil Protection when the event occurs.

The development of risk reduction strategies includes all aspects of risk management, from prevention to recovery. Civil Protection has a central role in ensuring a resilient approach for disaster risk reduction

The project aims at studying innovative approaches for the development of integrated flood risk scenarios taking into consideration critical specific issues of areas at risk and the consequences of high frequency/low damage events that affect them. High frequency floods still involve and require mitigation actions on the part of civil protection and citizens before floodwaters inundate the land and directly affect assets that can benefit from enhanced protocol development based on realistic scenarios.

In particular, the main idea is to develop a supporting decision tool for the comparative analysis of disaster reduction strategies in flood risk management, with a specific interest in



studying the functional vulnerability of critical infrastructures in order to preserve their efficiency during and after hazardous events.

This project will contribute to risk prevention addressing two challenging goals: firstly deriving consistent risk scenarios at the micro-scale, for frequent events, focusing on strategic infrastructures vulnerability; secondly defining effective strategies for managing emergencies, focusing on the individuation of areas at risk of isolation, best routes to reach populations, recovery areas, good practices to avoid the presence of citizens and cars in flooded areas.

The project also aims to support Civil Protection actions of risk reduction in at-risk territories during and after emergencies, keeping at-risk citizens safe, through both flood water avoidance and minimising disruption. Flood events cause both direct and indirect impacts, referring to the losses or disruption caused by the direct contact with flood water or due to the secondary effects.

For example. Transport infrastructures, can suffer structural (direct) damages after a flood event and, consequently, lead to an isolation of flooded and also not flooded areas (indirect effect). The efficiency of urban infrastructure is maintained if their disruption does not cause injuries and their functional role is substituted by other infrastructures following alternative routes. Identifying strategic buildings for citizen people recovery, defining the transferability transitivity and partial transitivity damage states and providing the alternative routes in both eventualities – including considerations on people behaviour, human resources and costs of alternative actions – is an important contribution to mitigate events' consequences by maintaining efficient infrastructures during and after disasters. Event management protocols benefiting from such considerations.

The main activity of the PhD student will be at the Water Engineering Research Group at the University of Messina, which will be integrated with two training periods, one abroad (6 months) at University of Bristol (one of the main European centres on the topic of the thesis) for an improvement of knowledge to flood resilience for the transport infrastructure and one at the Department of Civil Protection of the Sicily Region to improve the aspects related to disaster reduction strategies during and after hazardous events.

Research team and environment

The research activity will take place at the Department of Engineering, University of Messina. Within the Research Group of Water Engineering and Hydrology coordinated by Prof. Giuseppe T. Aronica. The Group includes an Associate Professor and other members (PhD students, Post-Docs, Research Assistants) and cover research topics related to flood risk management and flood defense design, flood propagation modelling, hydrological and hydraulic modelling of flash floods and debris flows, flood vulnerability and damage evaluation, pluvial flooding, sustainable urban drainage systems. Flood early warning, stochastic hydrology applied to the analysis of extreme hydrometeorological events. The research activities are supported by several national and International grants in the field of



flood risk assessment and mitigation, damage evaluation, development of disaster risk reduction strategies. The Research Group collaborates with several other research groups in Italy (University of Palermo, IUSS Pavia, Polytechnic Milan, University of Naples, and others) and abroad (University of Exeter, University of Thessaloniki, University of Bristol, Middlesex University, University of Sarajevo and others).

Suggested skills for this research topic

The ideal candidate should have a background in civil and environmental engineering studies, in particular in the field of urban and riverine flooding, flood vulnerability and damage evaluation.

Familiarity with programming languages such as Matlab, R, Fortran, will be positively considered, as experiences in statistics, data analysis and socio-economic modelling will be an added value. Fluency in English, both written and spoken is recommended. Finally, the candidate should be strongly motivated to work in a collaborative environment, with an interdisciplinary approach. A willingness for international mobility is required



Curriculum: 2. Socio-Economic Risk and Impacts

A systemic framework for climate risk assessment and management

Reference Person: Arosio Marcello (marcello.arosio@iusspavia.it)

Host University/Institute: IUSS Pavia

Research Keywords: Systemic climate risk
Indirect climate impacts
Graph and network theory

Reference ERCs: PE8_3
PE6_6
SH1_6

Reference SDGs: GOAL 8: Decent Work and Economic Growth, GOAL 9: Industry, Innovation and Infrastructure, GOAL 13: Climate Action

Description of the research topic

Assessing the risk of complex systems to natural hazards induced by climate and its change is an important and challenging problem. In today's intricate socio-technological world, characterized by strong urbanization and technological trends, the connections and interdependencies between exposed elements are crucial. In this context of complex relationships, the scope of this research will be a paradigm shift in collective risk assessments: from a reductionist approach (i.e., based on the sum of the risk evaluated individually at each of its elements) to a holistic one (i.e., the whole system is a unique entity of interconnected elements, where those connections are considered to assess risk more thoroughly).

The research will progress on the activities at IUSS on the development of an innovative holistic approach (Arosio et al., 2020, "A holistic graph-based assessment approach for natural hazard risk of complex systems") that allows to analyze risk in complex systems based on a graph, the mathematical structure to model connections between elements. The approach proposes to represent the exposed elements of the system and their connections (i.e., the services they exchange, doi:10.5194/nhess-20-521- 2020) with a weighted and redundant graph. By mean of it, it assesses the systemic properties, such as authority and hub values and highlighted the centrality of some "critical" exposed elements. Furthermore, it is possible to use the graph as a tool to propagate the damage due to extreme climate events into the system, for not only direct but also indirect and cascading effects, and,



ultimately, to better understand the risk mechanisms of natural hazards in complex systems. Finally, the graph can also account for the resilience characteristics of the system according to the United Nations General Assembly definition.

Based on the state of art, internal and external to the IUSS's team, the candidate needs:

- to critically review the most recent literature, tools and database of collective risk assessment, with focus on climate-related hazards;
- to develop a novel methodology for the climate risk assessment using a systemic approach;
- to collaborate both with IUSS research team and the research team of the other Universities in the PhD consortium in a multi-disciplinary context;
- to disseminate results at international conferences and workshops

Research team and environment

IUSS mission is to provide advanced education to undergraduate and graduate students, as well as fundamental and applied research in the fields of Science, Technology, Engineering and Mathematics (STEM), and Human, Social and Life Sciences. At IUSS, PhD candidates will find an open multidisciplinary environment offering real opportunities for developing academic and professional tools for facing the challenges arising from increasing complexity and fast changes in the society and the environment. IUSS is always and actively committed towards internationalisation, inclusion and diversity. The selected candidate will join the research centre on Climate change impAct studies for RiSk MAnagement (CARISMA). The CARISMA team is composed by STEM and Social scientists working in the prism of climate change on: data analysis and modelling of Earth system and economic system processes; impact assessment of extreme natural events and anthropogenic activities on human and natural environments; risk management of natural and anthropogenic hazards; formulation and proposal of new economic, political and legal models of sustainable development.

For this scholarship a period of internship is planned at *CRIF SpA, Bologna*

Suggested skills for this research topic

The ideal candidate will have experience with most of these topics: quantitative risk assessment, graph theory, statistical analysis and large dataset. Theoretical knowledge is mandatory and professional application could be an advantage. The candidate should be passionate on research topics, hardworking, self-motivated, have an open-mindedness to look for new solutions and methods of doing things and creativity in analytical thinking to extract meaning from sets of data. The candidate should desire to join a multi- and interdisciplinary research team, open to learn new topics from other sectors and effectively communicate to colleagues with different background. Competence on programming languages is preferable.



Curriculum: 2. Socio-Economic Risk and Impacts

Sustainable mobility and policy action. Data informed decisions

Reference Person: Bergantino Angela Stefania
(angelastefania.bergantino@uniba.it)

Host University/Institute: University of Bari "Aldo Moro"

Research Keywords: Urban sustainable mobility
Consumers preferences
Urban transport services

Reference ERCs: SH7_9
SH7_7
SH7_6

Reference SDGs: GOAL 11: Sustainable Cities and Communities, GOAL 12:
Responsible Consumption and Production, GOAL 13: Climate
Action

Description of the research topic

The research project aims to investigate how virtuous forms of mobility - active mobility, shared mobility, public transport services (traditional, on-demand, ecc) - and innovative organisational forms and means of transport - private/collective unmanned vehicles and urban air mobility vehicles - can compensate for the environmental externalities associated with passenger and freight urban transport and, at the same time, also ensure greater equity and inclusion. The project aims to understand the determinants of sustainable mobility in different contexts: cities of different sizes, inner areas, islands, tourist areas, etc. The project will adopt a twofold approach:

(i) Analyse empirically and rationalize theoretically the factors that can support the transition to less impactful forms of urban transport and mobility, focusing on territorial factors (presence of urban mobility plans, city structure and distribution of services, state of infrastructure), regulatory and normative elements, demand factors (willingness of users to pay for and use a sustainable form of commuting, consumer attitudes and preferences using stated/revealed preferences and geospatial data, socio-economic factors that facilitate modal shift) and supply factors (product design and mobility planning that maximise the use of sustainable commuting and last-mile logistics, pricing strategies, service density, urban policies, public funding, design, technologies, etc);



(ii) Define and assess elements for the design of public policies and incentives to enhance the transition and understanding relevant drivers that may potentially improve or worsen their results by triggering complementarities or trade-offs.

The candidate will be encouraged to adopt a multi-disciplinary approach and use a wide range of tools such as multi-criteria analysis, discrete choice models, spatial econometrics using current users GPS data and available satellite data, network analysis, Big data and machine learning techniques, agent-based, behavioural and experimental economics methods.

The overall outcomes of the project are expected to be high level research results, potentially worth

consideration in highly reputed international journals or other publication outlets, and will be presented in top conferences in the relevant fields (e.g. Transport economics, Industrial organization, Energy and Environmental Economics conferences). They are however expected to also produce relevant policy insights.

Research team and environment

The project will benefit of the very lively and high level research environment of the Laboratory of Applied Economics (LEA) of the Department of Economics, Management and Business Law (DEMDI) of the University of Bari. The LEA team is made up of about 20 researchers actively involved in the mission of carrying out frontier research and high-level doctoral education in Transport and Infrastructure Economics, Territorial analysis, Tourism and Sustainability. The research team is lead by Professor Bergantino, the scientific referent of the research, full professor of Applied Economics and Transport Economics. Professor Bergantino has held and currently holds senior positions in the transport sector at the national level and has cooperated with a number of international organisations (OCSE, ITF, UNCTAD,...). The high quality of research is testified (among other things) by the award of the Scientific coordination of the Spoke on "Territorial Sustainability" (spoke 7) of the national PNRR P9 project in "Growing Resilient, INclusive and Sustainable". The candidate will have the opportunity to interact with PhD students of the house, and to get advised by top-scholars who will be involved as a part of the PhD program in a truly interdisciplinary environment such as the one that has been involved in the I and II edition of the Apulian Summer School in Transport Economics and Infrastructures (ASTEI) and in the internal PhD faculty. Additional advising and visiting opportunities may come from the international network of the LEA (Università Autonoma di Barcellona, University of Warwick, Erasmus University of Rotterdam, University of Ghent, Free University of Amsterdam, Georgetown University...).

Suggested skills for this research topic

The ideal candidate has a degree in economics or related fields and, preferably, a good quantitative background (statistics and/or econometrics), analytical capabilities, the ability to handle and analyze large datasets and a strong interest in learning advanced techniques



for analysis. The interdisciplinarity of the project may also imply, in principle, the possibility of mixed approaches (quantitative/qualitative). Fluency in English is recommended.



Curriculum: 2. Socio-Economic Risk and Impacts

Climate Change Impact on Economic Systems and Policies for an Orderly Transition

Reference Person: Caiani Alessandro (alessandro.caiani@iusspavia.it)

Host University/Institute: IUSS Pavia

Research Keywords: Climate Change
Macroeconomic Modeling
Physical and Transition Risks

Reference ERCs: SH1_L1
SH1_L12
SH1_L3

Reference SDGs: GOAL 8: Decent Work and Economic Growth, GOAL 10: Reduced Inequality, GOAL 13: Climate Action

Description of the research topic

The candidate should have a background in economic studies, in particular in the field of macroeconomic analysis. His training and research activity will center on the study and development of models aimed at achieving a better understanding of the interactions between climate, the environment, and the economy. The focus will be on the effects of climate change on the real and financial spheres of the economy, with the aim of identifying the most suitable economic policies and the regulation schemes to mitigate the economic risks connected both to global warming and to the transition from a carbon-intensive to a low-carbon economy. The candidate will be encouraged to adopt a multidisciplinary approach and to use a wide range of tools such as dynamic heterogeneous-agent models (.E.G. Agent-Based Models), Integrated Assessment Models, econometric models, network analysis and machine learning techniques, behavioral and experimental economics methods. The research activity will be carried out in the research centre on Climate change impAct studies for RiSk MANagement (CARISMA) of IUSS.

Research team and environment

IUSS mission is to provide advanced education to undergraduate and graduate students, as well as fundamental and applied research in the fields of Science, Technology, Engineering and Mathematics (STEM), and Human, Social, and Life Sciences. At IUSS, PhD candidates will find an open multidisciplinary environment offering real opportunities for developing academic and professional tools to face the challenges arising from increasing complexity



and fast changes in the society and the environment. IUSS is always and actively committed towards internationalisation, inclusion and diversity. The selected candidate will join the research centre on Climate change impAct studies for RiSk MAagement (CARISMA). The CARISMA team is composed by STEM and Social scientists working in the prism of climate change on data analysis and modelling of Earth System and Economic System processes; impact assessment of extreme natural events and anthropogenic activities on human and natural environments; risk assessment and management of natural and anthropogenic hazards; and formulation/proposal of new economic, political and legal models of sustainable development.

Suggested skills for this research topic

Background in Economic Studies

Good Programming Skills

Econometric & Statistical Skills



Curriculum: 2. Socio-Economic Risk and Impacts

Innovative start-ups for a more innovative and sustainable economy

Reference Person: Colombelli Alessandra (alessandra.colombelli@polito.it)

Host University/Institute: Politecnico di Torino

Research Keywords: Innovative start-ups

Eco-innovations

Digital technologies

Reference ERCs: SH1_9

SH1_10

SH1_12

Reference SDGs: GOAL 9: Industry, Innovation and Infrastructure, GOAL 12: Responsible Consumption and Production, GOAL 13: Climate Action

Description of the research topic

The research is positioned at the intersection between entrepreneurship and sustainable development. The project will analyse the trends and practices of innovative companies responding to the challenges of climate change and acting towards a sustainable economy within the context of the European Green Deal, focusing on the green strategies of innovative startups. The project includes three interrelated research themes:

1) **INNOVATION:** What is the role of start-ups for the generation and dissemination of green technologies in support of a more innovative and sustainable economy? Are these innovations linked to other relevant aspects of sustainability, such as diversity and inclusion, resilience (especially in the post-COVID world) and good governance?

2) **PERFORMANCE:** How can start-ups jointly leverage digital and green technologies and best practices to become more competitive while helping the transition to a more sustainable economy? What are the key trade-offs? Which companies are the most successful at linking climate risk management, eco-innovation and financial outcomes?

3) **POLICIES:** How much do regional, national and European policies and institutions encourage and protect the eco-innovative and sustainable activities of entrepreneurs? Are other policies that encourage green entrepreneurship (labels, reporting requirements, value



chain disclosure, anti-greenwashing actions) complementary to those targeting innovation systems?

Research team and environment

Beyond Prof. Colombelli, the closest research team includes another researcher RTD-A (Chiara Ravetti) who specializes in socio-economic sustainability and has already been working with Prof. Colombelli on the identification of green innovative start-ups in the Italian context; and another PhD student working on the research project "Sustainable business strategy, organization and innovation". Furthermore, the doctoral student will be part of the Department of Management and Production Engineering of the Politecnico di Torino, which concentrates economics and business expertise across numerous areas related to the research project (strategy, digitalization, industry 4.0, innovation, entrepreneurship, social innovation, incubators). Moreover, the PhD student will be part of the Entrepreneurship and Innovation Center (EIC), a knowledge-hub specialized in entrepreneurial and innovative ecosystem. During the PhD, the doctoral student will have access to the equipment of the Laboratory of Production and Economics (LEP) and, in particular, the following tools: software for economic-statistical analysis (Stata, Matlab), proprietary databases with characteristics of companies and patents such as Amadeus and Orbit, data on innovative start-ups, SMEs and particular cases of sustainable entrepreneurship (B-corporations).

Suggested skills for this research topic

The ideal candidate is a proactive, highly motivated and independent person, with an understanding of the economic and business challenges posed by climate change and sustainability transitions, capable of quantitative as well as qualitative data analysis (knowledge of econometrics and statistics constitutes a preferential skill, but is not a prerequisite)



Curriculum: 2. Socio-Economic Risk and Impacts

Climate and sustainable finance: financial instruments and policies

Reference Person: Ughetto Elisa (elisa.ughetto@polito.it)

Host University/Institute: Politecnico di Torino

Research Keywords: Climate finance
Sustainable finance
Financial instruments

Reference ERCs: SH1_5
SH1_6
SH1_12

Reference SDGs: GOAL 13: Climate Action, GOAL 17: Partnerships to achieve the Goal

Description of the research topic

The research project relates to the area of sustainable and climate finance. The project is aimed at studying how the financial system intervenes to mobilize resources to mitigate the effects of climate change on the economic, innovative and financial performance of firms. A mapping of the financial instruments will be combined with a quantitative analysis based on the construction of a unique database of policies, extreme climate events, institutional investors and firms' financial accounting and innovative performance data. The aim of the analysis will be to explore the effect that extreme climate events have on firms' innovative dynamics and economic and financial performances and the related use of financial instruments and policies to mitigate such effects. The data will be analyzed through the use of econometric techniques. The investigation approach will be micro-founded. One of the main catalysts to develop sustainable businesses are for example venture capital funds that operate in the sustainable field (e.g. Cleantech venture capitalists). One of the potential research area could be to gain insight on the role of venture capitalists as supporters and promoters of sustainable businesses and the potential barriers and opportunities associated with this. A detailed analysis of the funds' characteristics, investment strategies and target ventures and an analysis of the results that these funds obtain in terms of investments, committed capital and economic and financial performance of invested firms will be an expected outcome of the project.

Research team and environment



The research activity will take place at Politecnico di Torino but the research project will be conducted in collaboration with the Observatory on Climate Finance from Politecnico di Milano and the Bureau of Entrepreneurial Finance, a research center that involves teams of academics from both Politecnico di Milano and Politecnico di Torino. The Ph.D student will have access to data gathered by the Observatory on Climate Finance and other relevant proprietary databases on firms' accounting data, financing sources and patents.

Suggested skills for this research topic

The PhD student should have good skills in data mining and data analysis. Knowledge of Stata software is particularly appreciated.



Curriculum: 2. Socio-Economic Risk and Impacts

Business strategies for sustainability management: the role of eco-innovative processes

Reference Person: Frey Marco (marco.frey@santannapisa.it)

Host University/Institute: Scuola Superiore Sant'Anna, Pisa

Research Keywords: Eco-innovation

Sustainable processes

Sustainability Management

Reference ERCs: SH 7_6 Environmental and climate change, societal impact and policy

SH 7_5 Sustainability sciences, environment and resources

SH 1_10 Management; strategy; organisational behaviour

Reference SDGs: GOAL 9: Industry, Innovation and Infrastructure, GOAL 12: Responsible Consumption and Production, GOAL 13: Climate Action

Description of the research topic

The central theme of the research will concern the development of management and technical solutions to combine an eco-innovative approach at the business level with sustainability challenges. The research will focus on innovative and sustainable processes, strategies, and tools that companies adopt and implement. The eco-innovative approach will be explored to understand how companies may create and share value by contributing to more sustainable development and a circular economy. The role that digital tools may have to support the business sector in eco-innovation adoption can also be explored. Moreover, the project may explore the impact sustainable innovative business strategies have at a policy level. The project is built around key research questions: 1) What is the role companies have in implementing and adopting eco-innovations? 2) How can eco-innovative companies create and share value by contributing to circular economy? 3) How may digital tools support eco-innovation in companies? 4) What are the impacts of eco-innovation on green and sustainable policies?

The research will contribute to the literature on sustainable innovation management and sustainable development.

Research team and environment



The research will take place at the Sustainability Management Lab of the Institute of Management. The Institute of Management has been running for more than ten years a Ph.D. In Management Innovation, Sustainability and Healthcare. The Sustainability Management Lab, composed of more than 40 researchers, is active in research on sustainability for eighteen years. More than 30 projects funded by the European Commission and 150 national projects or projects commissioned by companies have been carried out. Topics include, among others, circular economy, sustainable production and consumption, efficient use of resources, energy transitions, valuation of natural capital, and ecosystem services. The Sustainability Management Lab activities also concern companies' mitigation and adaptation strategies for climate change.

The most used tools are:

- Statistical and econometric analysis.
- Life Cycle Assessment.
- Organizational Network Analysis.
- Ad hoc assessment tools (for example, measuring the circular economy).

There are observatories and laboratories such as those on safety management or management of packaging with consortia to link research and business strategies, or more than ten-year partnerships with institutions and companies. There are also opportunities related to training activities, particularly with the GECA post-graduate degree (Environmental Management and Control, active for 25 years) and with Schools on Circular economy.

Suggested skills for this research topic

We are looking for candidates with economic and business management skills, with particular reference to sustainability management.



Curriculum: 3. Technology and Territory

Ocean space utilization for energy harvesting purposes

Reference Person: Arena Felice (arena@unirc.it)

Host University/Institute: Mediterranean University Of Reggio Calabria

Research Keywords: Water wave mechanics

Energy harvesting

Offshore engineering

Reference ERCs: PE8_3

PE8_5

PE8_6

Reference SDGs: GOAL 7: Affordable and Clean Energy, GOAL 9: Industry, Innovation and Infrastructure, GOAL 13: Climate Action

Description of the research topic

The research program deals with the development of offshore islands (as fixed or floating structures) for ocean space utilization, in which wave (marine) energy is exploited for energy supplying and to reduce CO2 emissions.

The research activities will be developed by considering:

- analysis and development of innovative models, analytical and/or numerical, of marine structures (i.e. Fixed breakwater, offshore floating structures), with OWC devices;
- study of the hydrodynamics problems for the modelling of large floating structures, including structures in which OWC devices are embodied;
- risk analysis of marine structures in severe meteocean conditions, by taking into account extreme waves during sea storms; this analysis will include the study of the action of extreme waves (freak waves) on the OWC wave energy converters;
- data processing from experimental activities with physical modeling of Oscillating Water Column systems, on fixed and floating structures. These data are available at NOEL laboratory.

Both Monte Carlo approaches and experimental data will be used for the analysis of the dynamic response.



The hydrodynamic analysis will be conducted in the context of the potential theory for an irrotational flow with a free surface (to determine excitation forces, added mass and radiated damping).

Research team and environment

The research team operates at the NOEL (Natural Ocean Engineering Laboratory): a laboratory established within UNIRC. It is composed by a highly specialized team working in the field of ocean engineering and marine energy. Actually, the team involves 1 Full Professor, 2 Associated Professor, 3 Researchers, 2 Post-docs and 2 PhD Students. The team has a 30-year experience in conducting field experiments on small-scale models of marine structures and of wave energy harvesters at the NOEL natural basin. This laboratory is a unique environment where experimentalists can pursue tests with the support of sensors, acquisition data center and specialized personnel established permanently in the laboratory infrastructure facing the basin (for details see www.Noel.Unirc.It).

The mission of this group is to utilize the knowledge acquired in the field of marine and civil engineering to develop novel methodologies in the analysis of the wave phenomena and of the wave climate, for wave structure interaction (floating or fixed structures). The group is also involved in the analysis of coastal structures for protection purposes (for instance caisson breakwaters), in the development of novel coastal structures hosting devices for wave energy harvesting, in the development of experimental activities for testing floating offshore wind turbine models, and in the testing of the prototype of an offshore multipurpose platform for fish farming and exploitation of wind and wave energy (Horizon 2020 project The Blue Growth Farm 774426).

Suggested skills for this research topic

Fluid mechanics

Wave mechanics

Random process theory

Dynamics of structures

Numerical analysis

Physical modelling

Algorithm coding (Fortran, Matlab, Python, etc.)



Curriculum: 3. Technology and Territory

Innovative Catalysis for Sustainable Synthesis of Active Pharmaceutical Ingredient

Reference Person: Fini Francesco (francesco.fini@unimore.it)

Host University/Institute: Università degli Studi di Modena e Reggio Emilia

Research Keywords:	Asymmetric Organocatalysis Supramolecular- and photo-catalysis Sustainable synthesis of Active Pharmaceutical Ingredients
Reference ERCs:	PE5_13 homogeneous catalysis PE5_17 organic chemistry PE5_16 supramolecular chemistry
Reference SDGs:	GOAL 3: Good Health and Well-being, GOAL 9: Industry, Innovation and Infrastructure, GOAL 12: Responsible Consumption and Production

Description of the research topic

Catalysis is recognized as one of the most renowned sustainable methodology in organic synthesis for the production of bioactive molecule. In the last twenty years organocatalysis (small-organic molecule metal-free catalysis) has been defined as the third pillar of catalysis by D.W.C. MacMillan and B. List. The Royal Swedish Academy of Science selected them as Nobel Prize of Chemistry recipients for the great advancement in Science and Society. The academic community start to develop novel modes of activation of substrates and to revisit traditional organic reactions with the new paradigm. Tremendous development in terms of sustainable and green chemistry has been attained, but the industry has been reluctant to apply the novel catalysis to the syntheses of active pharmaceutical ingredients (API). Still, few organocatalytic processes developed by industry have been disclosed, showing that organocatalysis and in general innovative catalysis are the tools of choice for a green and bright future in the field of chemistry and in general for humanity.

The research topic will be focused for the development of innovative catalysis for the synthesis of building block in organic synthesis and medicinal chemistry. The development of sustainable green processes for the synthesis of API or even applying novel methodology for the synthesis of patent-expired active principles (generic) will be on paramount importance to make medication as affordable as possible, eventually changing the pharmaceutical



market. In this regard avoiding the use of expensive and impactful heavy metal, towards small organic molecule from the Natural pool will be the key to move on more renewable resources.

Organocatalyst or photocatalyst could be used individually as green catalyst applied to organic synthesis. Then, a synergistic approach might be taken in consideration where more than one catalytic species activate several reaction partners for the synthesis of the products. In addition, at the edge of organocatalysis lies the supramolecular catalysis, where a small organic molecule self-aggregates into supramolecular structure in an orderly fashion taking the activation of substrates to a level never seen before.

Careful attention will be devoted for the application of innovative catalysis to traditional organic reaction. In this regard multicomponent reactions (MCR) are among the most wanted process: by mixing more than two substrates and reagents the synthesis of complex molecules is achieved without further human intervention, eliminating purification process and energy. Great examples are represented by the Passerini and Ugi reactions, or Mannich and Strecker reactions.

The results obtained will be disseminated at national and international scientific meetings, and published in top-tier international scientific journals. The aim is also to raise public awareness on the importance of research and innovation. Specific training to the researchers engaged in the project to manage social media profiles and to public speaking and dissemination.

Research team and environment

The PhD candidate will be part of a young and growing research group working on innovative catalysis in particular on photo-, supramolecular- and organocatalysis where novel sustainable methodologies are developed with the aim to change the world.

Group members and the candidate will interact with diverse science and be exposed to a multidisciplinary environment; besides participating in international conferences and meetings. They will be encouraged to undertake personal development and professional courses, and to develop soft skills.

The reference person has approximately 30 square meter of lab space at the Department of Life Sciences, Università di Modena e Reggio Emilia. The lab is fully equipped with fume hoods, rotary evaporators, UV lamps and several high vacuum and inert-gas lines for the most challenging organic synthesis procedures. The group has access to 100 square meter common laboratory where are placed an in-house HPLC apparatus for organic and chiral compounds separations with PC interface and Polarimeter for chiral compounds characterization. The lab space can accommodate three to four researchers. The group members have access to the CIGS (Interdepartmental center for Large Instrumentations), a facility where are placed two NMR spectrometers (400 and 600 MHz) together with Mass



Spectrometry analyzers(UHPLC coupled with Q Exactive™ Hybrid Quadrupole-Orbitrap™ Mass Spectrometer, ion Trap LC/MS).

Suggested skills for this research topic

The candidate should be able to teamwork in a multidisciplinary environment, thriving for knowledge and thinking outside of the box. It should have the desire to explore novel chemistry without dogma driving the research towards the expected and the unexpected.

Solid foundation of organic chemistry is of paramount importance, proficiencies in catalysis will be preferred, together with strong communication skills in an international environment.



Curriculum: 3. Technology and Territory

Closing the water cycle using climate and hydraulic models over Europe

Reference Person: Fosser Giorgia (giorgia.fosser@iusspavia.it)

Host University/Institute: IUSS Pavia

Research Keywords: Soil hydrology and modelling

Land surface – Atmosphere – Sea interaction

Climate modelling

Reference ERCs: PE10_21

PE10_2

PE10_3

Reference SDGs: GOAL 11: Sustainable Cities and Communities, GOAL 13: Climate Action, GOAL 15: Life on Land

Description of the research topic

Most of the meteorological and climate models describe terrestrial hydrological processes in an oversimplified way, often adopting a vertical one-dimensional approach that does not consider the lateral redistribution of surface and subsurface water. It is well known that the misrepresentation of hydrological processes affect soil moisture and thus the estimation of sensible and latent heat fluxes in climate models.

In recent years coupled atmospheric–hydrological models have been developed to include the impact of the channel and terrain routing of the surface and subsurface water flows into atmospheric models. This has led to a better representation of the precipitation patterns and atmospheric responses to soil moisture. In addition, these models allow to simulate flooding events, which are among the most common natural disasters leading to deaths, destruction, and economic losses. In the Euro-Mediterranean region, such events are expected to change in frequency and intensity under climate change. In this context, atmospheric–hydrological models can be an important tool to identify future changes in vulnerability linked to flooding and thus contribute to the definition of effective management and adaptation strategies.

Within the PNRR Project “National Centre for HPC, Big Data and Quantum Computing – Activity Spoke4: Earth & Climate”, one of the aims is the development of Earth System Models



(ESM). This fellowship is in collaboration with the Climate Modelling Laboratory of ENEA, one of the partners of the Spoke 4, that already developed and uses an ESM. The current ESM version is based on the following model components for atmosphere, ocean and river scheme: Weather Research and Forecasting model (WRF), MITgcm, HD.

This research aims to investigate the added values of using a fully coupled atmosphere, ocean and river model for the closing the water cycle, representing precipitation patterns and floods. In this context, the candidate will validate and compare results from different hydrological models in their ability to simulate both river discharge and flooding of specific extreme events as well as in terms of climate statistics. In particular, two hydrological models will be considered: the new HD version and WRF-Hydro, which parameterizes overland and river flow routing and subsurface routing in the 2 m soil column and also includes a ground water bucket model. In addition, the candidate will implement the coupling between ENEA ESM and WRF-Hydro, thus linking terrestrial hydrological with land-atmosphere processes and allowing feedback between the two. Among these feedbacks, the river routing is a key variable for the water cycle closure between atmosphere, land surface and ocean in regional Earth System Models.

Research team and environment

The selected candidate will join the research centre on Climate change impAct studies for RiSk MAnagement (CARISMA) within IUSS, Pavia. The CARISMA team is composed by STEM and Social scientists working in the prism of climate change on: data analysis and modelling of Earth system and economic system processes; impact assessment of extreme natural events and anthropogenic activities on human and natural environments; risk management of natural and anthropogenic hazards; formulation and proposal of new economic, political and legal models of sustainable development.

Part of the research activity will be conducted at the Climate Modelling and Impact Laboratory of the National Agency for New Technologies, Energy and Sustainable Economic Development (ENEA) at the Casaccia Research Centre (Rome). The primary mission of the Laboratory is to study and model the climate system for projecting the impacts of climate variability and future scenarios on society and natural resources at spatial scales most relevant to humans, ecosystems and the national productively system. The numerical models developed and applied in the Laboratory are of different complexity and realism spanning from global models to high resolution regional climate models mainly focused on the Euro-Mediterranean area. The Laboratory promotes the development of Climate Services at both national and international level, implementing climate information transfer protocols and products for the energy, water and coastal region management, food emergency, tourism and agriculture. The laboratory is actively involved in international and national research initiatives on climate, energy and environment.



Suggested skills for this research topic

The ideal candidate should have experience with most of these topics: hydrological models, statistical analysis with large dataset and climate. Theoretical knowledge is mandatory and professional application could be an advantage. Competence on programming languages and numerical modelling are required. The candidate should be passionate on research topics, hardworking, self-motivated, have an open-mindedness to look for new solutions and methods of doing things and creativity in analytical thinking to extract meaning from sets of data. The candidate should desire to join a multi- and inter-disciplinary research team, open to learn new topics from other sectors and effectively communicate to colleagues with different backgrounds.



Curriculum: 5. Agriculture and Forestry

Innovative and integrated processes for sustainable management of water resources

Reference Person: Spano Donatella (spano@uniss.it)

Host University/Institute: University of Sassari

Research Keywords: Smart agriculture
Integrated water management
Climate change adaptation

Reference ERCs: LS9_8
PE10_17
PE10_3

Reference SDGs: GOAL 12; GOAL 13; GOAL 17

Description of the research topic

The CC and the growing demand for sustainable agricultural crops push the sector to a more efficient use of natural resources, especially in the Mediterranean area. The overall goal is to improve the Integrated Water Resource Management and sustainable irrigation through the implementation of innovative tools, smart water services and solutions, for public and private use, while contributing to climate resilience. In particular, a suite of innovative tools will be developed that will allow monitoring and control (IoT), interoperability and standardization (WoT), also through the use of complex dynamic models combined with data analysis, with support tools, decision making and intelligent data visualization. The combination of these tools will allow simulating complex interactions and feedback across different time horizons and multiple related environmental and socio-economic dimensions, to arrive at guidelines and adaptation strategies to CC. All the innovations can be tested on a large scale in basins of some Mediterranean countries (eg, Italy, Jordan, Lebanon and Tunisia) where water efficiency is a prerequisite to cope with water scarcity and CC.

Research team and environment

The research activity will benefit of the facilities of the Department of Agricultural Sciences of University of Sassari and of the research network of the CMCC Foundation. The team will be composed by multidisciplinary researchers, including specialists on climate modeling, crop water management, smart agriculture, sustainable development, and climate change adaptation. The activity will be conducted in the framework of some EU projects recently funded: the PRIMA Project ACQUAOUNT- Adapting to Climate change by QUantifying optimal



Allocation of water res0Urces and socio-ecoNomic inTerlinkages; the COST Action ON WATER-ENERGY-FOOD NEXUS FOR A LOW-CARBON ECONOMY IN EUROPE AND BEYOND; the H2020 Project NEXOGENESIS-Facilitating the next generation of effective and intelligent water-related policies utilising artificial intelligence and reinforcement learning to assess the water-energy-food-ecosystem (WEFE) nexus.

Suggested skills for this research topic

Competences in ecophysiology, agronomy, hydrology, ecosystem/crop processes, and mathematical and programming skills will be recommended



Curriculum: 6. Health and Ecosystems

Enzyme-based bio-devices for CO₂ conversion to chemicals and biofuels

Reference Person: Valetti Francesca (francesca.valetti@unito.it)

Host University/Institute: University of Torino

Research Keywords: Biocatalysts
CO₂ bioconversion
Bio-hybrid and photo-activated devices

Reference ERCs: LS1_2
LS1_7
LS9_1

Reference SDGs: GOAL 7; GOAL 9; GOAL 13

Description of the research topic

The research aims to exploit biocatalysts such as bacterial enzymes (hydrogenase -CbA5H- and formate dehydrogenase -FDH- from *C. Beijerinckii*) for GHG effect mitigation via CO₂ conversion to chemicals and biofuels. In this perspective it is in line with the curriculum-specific topic concerning the identification and evaluation of possible bio-based climate change adaptation and mitigation strategies, focusing on biotechnological approaches for GHG abatement and recycling.

The biocatalysts will be directly interfaced with photo-activated semiconductors such as titanium and zinc oxides and will be used to develop bio-cathodes that allow the production of bio-hydrogen and the conversion of CO₂ to formate by exploiting electrons carried by the semiconductor.

The system works either coupled to an anode capable of generating electrons or via direct solar photo-activation. The coupling of hydrogenase to TiO₂ has already been demonstrated and published by our research group. The system also allows a coupling (already tested) of the two enzymes CbA5H and FDH via a soluble mediator (MV) for the generation of formate from hydrogen and CO₂.

The advantage of using enzymes is a very low over-potential compared to inorganic catalysts as well as high turnover frequency and mild operating conditions.

To achieve biofuels production (such as bio-methanol) other biocatalysts necessary for conversion of formate to formaldehyde and then to methanol (formaldehyde dehydrogenase



or FaldDH, to reduce formate to formaldehyde and a suitable alcohol dehydrogenase -ADH- or methanol dehydrogenase -MDH- capable of converting formaldehyde to methanol) will be immobilized on the cathode layer.

The long-term aim is to propose a bio-based solution combining GHG mitigation and circular bio-economy.

Research team and environment

The Departments of Life Sciences and Systems Biology (DBIOS), and in particular the biochemistry group, led by prof. Gianfranco Gilardi (<https://www.Biochemistry-scienze.Unito.it/>), is providing expertise in enzyme-based and microbial biocatalysts and industrial biotechnology processes. The research is positioned at the interface between biology, biochemistry, chemistry and engineering, with a strong drive to exploitation for industrial competitiveness and improving society and human health. Facilities: The DBIOS laboratories offer facilities in molecular biology and protein expression (2 x10 L, fermenters, shakers), and purification (Akta and LC chromatography), 2D electrophoresis, HPLC, gas-chromatography, UV-vis and fluorescence spectroscopy, circular dichroism, 3 glove-boxes for microorganisms and enzymes sensitive to oxygen, diode array stopped flow, electrochemistry, Grazing angle FT-IR, contact angle, GPC-UV. The lab is certified ISO for certain processes and it is certified as a class 1 and 2 microorganism manipulation lab by the Italian Health Ministry. The DBIOS group can also access to all facilities of the centre NIS for nanostructured surfaces and materials and the Openlab facilities of the University of Torino.

Suggested skills for this research topic

Background in biochemistry, chemistry, material sciences and an interest in the interdisciplinary field of combining inorganic and photo-active or electro-active material with proteins.

The candidate should be prepared to be challenged with learning different techniques spanning from biology to chemistry and technological application.

Enthusiasm and curiosity for cutting-edge techniques and approaches to research are also useful. The work will also imply using glove-boxes and requires a good degree of precision and dedication, with time-consuming experiments.



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