

SSD: BIO/05

Title: *Effects of climate and extreme events on the distribution and demography of birds*

Supervisor: Luciano Bani

Short description: To date, most studies concerning the effect of climate change on ecological processes have focused on how species and ecosystems respond to climate change. However, recently, an increasing number of studies are highlighting how extreme weather conditions and events may emphasize the consequences of the long term changes, therefore having important implications in forecasting models aimed at implementing suitable conservation strategies for species and ecosystems. The aim of the research is therefore to assess how extreme events can induce negative ecological responses, which have an impact on the population, species or ecosystem. Since most of the studies in this topic refer to short-term investigations, evaluating their effect in the medium and long term would offer the chance of having a more comprehensive cognitive picture of the extent of the phenomenon. To achieve the aims of the research we will analyse the demographic trends and inter-annual fluctuations of nesting bird species as a function of extreme weather conditions and events in the wintering and breeding regions. The data currently available in the Department's dataset will be updated by collecting new data on birds during the breeding season (35% of the activity will be spent on the field) and the analyzes will be conducted in collaboration with the British Trust for Ornithology , UK)

SSD: AGR/14

Title: *Artificial Neural Networks (ANNs) applications in Digital Soil Mapping (DSM)*

Supervisor: Roberto Comolli

Short description: The research is part of the vast field of digital soil mapping, a technique that emerged in recent years, which makes use of various methods of spatialization of soil data (geostatistics, regression and classification techniques, machine learning), combined with traditional methods of cartographic study. The aim of the research is to verify the application of artificial neural networks of different nature and complexity in order to obtain high detail maps of soils and their characteristics, starting from field sampling campaigns and using satellite or drone images and geomorphometric techniques based on high quality DEMs; the study areas will be in the Alps (pastures and forests) and the Andes (paramo); a field:laboratory:elaboration ratio of 30:20:50 is estimated. The research will be carried out in collaboration with the University of Azuay of Cuenca (Ecuador); it is assumed a permanence abroad of 4-6 months.

SSD: BIO/07

Title: *Bio-Restoration: new biomaterials as innovative approach for Coral reef Restoration*

Supervisors : Paolo Galli & Simone Montano

Short description: The project focuses on coral reef ecosystems of the Maldivian Archipelago that, unfortunately, have been affected by severe coral bleaching events on 1998, 2005, 2010 and 2016, as well as outbreaks of CoTS outbreaks and coral diseases. Due to the synergic action of these threats, Maldivian coral cover the coral cover has declined by 50-80 percent in less than three decades. The project aims at 1) restoring a compromised Maldivian reef through an innovative coral restoration technique, based on 100% biodegradable materials. To achieve this goal, we will design, produce and use in the field non-toxic, bio-based scaffolds that can biodegrade in ocean water in a couple of years, which is the life-span permitting new coral recruits to settle, grow and achieve independence from the artificial substrate. 2) The core of the project will be the development of unique bio-based materials compatible with the ocean bio-habitat, and hence ready for preliminary testing in aquatic environments.

The project will involve the Maldivian National University, the Italian institute of Technology and the MaRHE center. Milano-Bicocca phd student will then install the material in the Maldivian site (approximately 3 months/year).

SSD: CHIM/12

Title: *Biochar for bioremediation*

Supervisor: Marina Lasagni

Short description: This work aims to explore, characterize and validate the use of a sustainable, environmentally friendly, porous material based on biogenic charcoal (biochar) mixed with other additives to be largely and sustainably spread in contaminated environments, and possibly recovered after the operation, for the definitive remediation of soil, sediments and industrial wastewater to acceptable standards, safely and definitively. Nanosized functionalized biochar will be produced by hydrothermal carbonization, starting from residual biomasses to obtain a valuable product to be exploited in the frame of circular economy concept. One of the possible uses will be the test in the *in-situ* treatment of contaminated groundwater. Possible collaboration with University of Alicante, Spain; University of Umea, Sweden; University of Riga

SSD: BIO/07

Title: *Evaluation and Mapping of Ecosystem Services in Protected Natural Areas*

Supervisors: Emilio Padoa-Schioppa & Harini Nagendra

Short description: Evaluation of Ecosystem Services is an increasingly important approach to the management and conservation of natural resources of Protected Areas worldwide, and this need a robust basic ecological research to support the effective governance of ESs

This research aims to evaluate and map ESs in different PAs following the most recent nomenclature and methodologies; The PhD student will be required to work both in collecting observation in the field (biodiversity surveys, soil sampling, biological sampling, plant ecology) also by using specific instruments (pedological tools, eDNA sampling tools, LAI sensor), in making analytical work in laboratory (soil chemical-analysis, biological analysis) and in doing computer work (database construction, mapping software, statistical analysis) for the quantification of ES. Study areas will be protected areas in the Alps and other mountain systems.

The project includes a period to spend abroad (min. 6 months, max. 12 months) working with different institutions. Azijm University (Bangalore, India) and other laboratories.

SSD: GEO/12

Title: *Effects of urbanisation on heavy precipitations*

Supervisor: Claudia Pasquero

Short description: Heavy precipitations have become more common in the last few decades and are expected to increase in the near future. In this research rain gauge datasets will be analysed with the aim of assessing the relative role of different anthropic activities (emissions of greenhouse gasses, pollution, land use change) in affecting heavy rainfall. The work will be done both at the global and at the local scale, with a focus on Northern Italy, and will be accompanied by the use of reanalysis data, and by numerical simulations with numerical weather prediction models. The project will be performed in collaboration with the University of Milan, with CIMA Foundation, and is part of the EU funded COST action on Mediterranean Cyclones.

SSD: GEO/04

Title: Quantitative Analysis of submarine geomorphological data for multidisciplinary geo environmental studies

Supervisor: Dr. Alessandra Savini

Short description: quantitative analysis of submarine geomorphological data accurately quantify terrain parameters and spatial pattern associated to submarine landforms, to relate them to geologically meaningful processes. Quantitative analysis at the GeoMarine Lab of Milano Bicocca University are operated over a set of multi-sensors 3D data, obtained from different sources in different submarine geomorphic settings and for applications that spread from geohazard assessment to marine spatial planning and ecosystem-based offshore resources management. The work will consist in acquiring acoustic remote sensing data in submarine environments and in using dedicated software to develop quantitative analysis within the framework of different projects carried out in collaboration with the Arctic University of Norway, University of Malta and OGS.

SSD: BIO/06

Title: Metal contamination: role in neurotoxicity and neurodegeneration

Supervisor: Chiara Urani

Short description: Epidemiological data have linked metal exposure to neurotoxicity and neurodegenerative diseases (e.g., Alzheimer's and Parkinson's disease), and to increased risk of developing amyotrophic lateral sclerosis. The general object of the project is the identification of the role of metals (essentials and non-essentials) in processes of neurotoxicity and neurodegeneration. The research work will comprise integrated approaches: 1) collection of data from available databases (e.g., ARPA) on different environmental matrices, and analyses of environmental samples from heavy contaminated areas with known increased incidence of neurodegenerative diseases; 2) in vitro approaches using 2D and 3D alternative methods for mechanistic and possible recovery studies; 3) development of methodologies based on joint Raman spectroscopy and in vitro methods to identify early biomarkers of metal exposure; 4) computing and statistics of data from different origins. The project has a major component of laboratory work, supported by field and data collection. The research work will be carried out in collaboration with: the Laboratory for Provenance Studies, (DiSAT), University of Milano - Bicocca; the EU Commission, Joint Research Centre (Ispra, VA); the Tissue Engineering Unit, Department of Clinical and Experimental Sciences (DSCS), School of Medicine, University of Brescia; the Department of Statistics, Computer Science, Applications, University of Florence. The candidate is expected to spend a period abroad possibly to implement Raman applications in the areas of the project.

SSD: BIO/07

Title: Evaluation of the quality of an environment through the analysis and definition of the most suitable acoustic and bioacoustic indicators characterizing the local soundscape

Supervisor: Giovanni Zambon

Short description: Sounds of geophonic or biophonic origin have been recognized a powerful proxies to characterize environmental quality or to detect the first symptoms of environmental stress, also with reference to human intrusion.

The aim of this project is to propose an ecoacoustics approach to investigate the state of community, ecosystems and landscapes as an innovative tool that can support and interact with other traditional technologies.

A widespread range of recording instruments, sensors and sampling techniques allow to acquire sounds for long periods in terrestrial and underwater context; at the same time, statistical analysis based upon different acoustic metrics is the way to define the best indicators which can return a picture of the environment and its dynamics.

Collaborations with the following universities are planned to carry out the activities:

- University of Parma - Department of Environmental Technical Physics
- University of Palermo - Department of Zoology
- University of Urbino - Department of Basic Sciences and Foundations
- University of Barcelona La Salle - Department of Engineering

During the PhD period, the student is expected to stay at the University of Barcelona for a period of at least 6 months

SSD: CHIM/12 – BIO/19

Title: Factors driving bioaerosol composition and effects

Supervisors: Andrea Franzetti, Ezio Bolzacchini e Luca Ferrero

Short description: Since the first studies of aerobiology of the 19th century when Pasteur cultivated microorganisms from the air for tracing airborne pathogens, many studies showed the high diversity of the microbial communities in the atmosphere. Bioaerosols, which include plant debris, pollen and microorganisms like bacteria, fungi and viruses, can represent a significant fraction the atmospheric aerosol in both outdoor and indoor environments. The recent COVID-19 pandemics highlighted the importance of a better understanding of the factor affecting the transport, abundance, metabolic activity and vitality of airborne microbial populations. Indeed, the question whether atmospheric chemistry and physics might be controlling factors in determining the survival and development of microbial taxa with specific functions in the atmosphere remains open. This PhD research project aims at investigating the environmental and anthropogenic factors affecting the structure and the metabolic traits of airborne microbial communities. In the indoor environments, the research activity will focus on bacteria and virus taxa with relevant potential effect on human health and biodeterioration. Cutting-edge technologies for chemical and microbiological characterization of the aerosol will be applied, including metagenomics and metatranscriptomics. The activities will be carried out at the department of Earth and Environmental Science in a collaborative effort among the POLARIS research center (<https://polaris.unimib.it/>), the research groups of environmental microbiology and atmospheric chemistry, and INAIL.