PhD Program in Civil, Chemical and Environmental Engineering
Curriculum in Fluid Dynamics and Environmental Engineering

Industrial Projects

June 2024 Call, XL cycle - Starting date: November 1 st 2024

The research projects submitted for the admission to the PhD program must be prepared in accordance to one of the projects listed below. Click on the Title to go to the Project.

A synergistic intelligent approach in atmospheric science: from weather nowcasting to climate change assessment (with ARPAL) – FSE POR REGIONE LIGURIA fellowship

Cloud ready data infrastructure and operational ocean downstream products (with ETT) – FSE POR REGIONE LIGURIA fellowship

AI4Good: satellite image processing with artificial intelligence for applications relevant to United Nations Sustainable Development Goals (SGDs) (with A-SIGN; reserved to A-SIGN employee)

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Project: A synergistic intelligent approach in atmospheric science: from weather nowcasting to climate change assessment

Brief Description:

In this project Artificial Intelligence (AI) will be exploited as the cornerstone for addressing two critical aspects of atmospheric science: climate change assessment and nowcasting of weather events including sea state and severe events in the marine context (such as mists and waterspouts). By integrating AI with traditional modeling strategies, we aim to enhance our understanding and predictive capabilities across both domains. For climate change assessment, AI algorithms will analyze vast regional model datasets to identify trends and patterns in extreme weather conditions such as precipitation, wind, lightning, and temperature. This analysis will help predict long-term changes and assess their potential socio-economic impacts. Simultaneously, AI will be utilized in the nowcasting of precipitation and other severe weather events to provide accurate, short-time forecasts also in the context of sea assessment and induced meteo risk. This immediate application of AI in nowcasting will improve emergency preparedness and response strategies, significantly reducing the potential risks associated with sudden weather changes. By harnessing the power of AI, this project aims not only to provide a more robust analysis of climate variability and its impacts but also to enhance the timeliness and accuracy of weather predictions. The dual application of AI in both long-term climate modeling and short-term weather forecasting represents a holistic approach to environmental and meteorological challenges, guiding policy decisions and preparedness strategies to safeguard society against the adverse effects of climate change.

The project will be performed in collaboration with ARPAL Agenzia Nazionale per la Protezione dell'Ambiente Ligure.

Referent: Andrea Mazzino (andrea.mazzino@unige.it)

Relevant links: https://rubrica.unige.it/personale/VUZCWV1p
https://www.arpal.liguria.it/

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Project: Cloud Computing Optimization and Open Science for Coastal and Maritime Downstream Applications

Keywords: Cloud Computing; Big Data; Downstream Applications; Open Science; Coastal; Maritime; FAIR

Brief Description:

The project focuses on optimizing cloud computing technologies to support downstream applications and promote open science initiatives in coastal and maritime climates. These regions face unique environmental challenges, requiring efficient and effective management of vast amounts of data generated from instruments, satellite imagery, and numerical models, among others.

The primary goals of this research are to develop robust frameworks and algorithms that enhance the performance of cloud-based systems in processing and analyzing environmental data. By doing so, the project aims to facilitate more accurate climate modeling, improve environmental monitoring, and support sustainable decision-making processes. Furthermore, the project will emphasize the principles of open science, ensuring that data, tools, and results are accessible and reusable by the broader scientific community.

Key objectives include:

- Data Integration and Management: Create methods for seamless integration and management of heterogeneous datasets from coastal and maritime sources within cloud environments.
- Optimization Algorithms: Develop and optimize algorithms for efficient data processing, storage, and retrieval to support real-time analytics and predictive modeling.
- Support for Downstream Applications: Design cloud-based solutions that cater to specific downstream applications such as disaster management, coastal erosion monitoring, and marine biodiversity conservation.
- Open Science Frameworks: Implement open science practices by developing tools and platforms that ensure transparency, reproducibility, and accessibility of research data and methodologies.
- Scalability and Sustainability: Ensure that the cloud computing solutions are scalable and sustainable, capable of handling increasing data volumes and evolving environmental challenges.

This project will bridge the gap between advanced cloud computing technologies and practical environmental applications, fostering a collaborative scientific environment.

Referents: Giovanni Besio (giovanni.besio@unige.it), Andrea Lira Loarca (andrea.lira.loarca@unige.it)

Relevant links: meteocean.science

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Project: AI4Good: satellite image processing with artificial intelligence for applications relevant to United Nations Sustainable Development Goals (SGDs)

Keywords: Artificial Intelligence, Satellite Image Processing, Sustainable Development Goals

Brief Description:
This project is in line with the AIforGood research supported by the United Nations, to promote technology innovation to solve big human challenges and impact people's lives today.

The project will involve an in-depth, critically analysed literature search to better highlight the specific research objectives. It will also be of great importance to acquire a basic understanding of the main sensors and satellites that enable multispectral data to be obtained and of the reanalysis satellite products that can be used for the research purposes inherent to the PhD.

The research will therefore focus on open issues relating to the analysis of optical, multispectral images with reference to the following application areas: air quality, climate change and disaster management.

For each of these application areas, an innovative methodological approach will be explored through the use of AI techniques. In particular, the following issues will be addressed through the application of Artificial Intelligence techniques:

- advanced analysis techniques and use of satellite images for the prediction of pollution data;

- advanced analysis techniques and the use of satellite images for the prediction of atmospheric phenomena;

- techniques for processing spatio-temporal elements;

- image prediction models (or pixel-level regression)

- downscaling techniques for satellite images.

The Position is reserved to A-SIGN employee.

Referent: Bianca Federici (bianca.federici@unige.it)

Relevant links: https://ai4good.org/

https://aiforgood.itu.int/

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