Università di Genova | **DICCA** Ph.D. PROGRAM IN CIVIL, CHEMICAL AND ENVIRONMENTAL ENGINEERING

PhD Program in Civil, Chemical and Environmental Engineering
November 2023 Call, XXXIX cycle - Starting date: March 1st 2024

Curriculum in Fluid Dynamics and Environmental Engineering

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 Thematic you are interested in to see the full list of projects.

Project: Hindcasting and forecasting the triggering and dynamics of marine sediment gravity flows,
Industrial partner Weather Water Sand

Project: Operational tools for dredging management: from legislative framework to environmental management,
Executive Ph.D. (reserved to candidates from Marina Militare)

Project: Multispectral and hyperspectral remote sensing data for integrated monitoring and analysis of the morphological evolution of the coastal zone,
Executive Ph.D. (reserved to candidates from Istituto Idrografico della Marina Militare)

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Project: Multispectral and hyperspectral remote sensing data for integrated monitoring and analysis of the morphological evolution of the coastal zone.

Keywords: Remote sensing, multispectral images, hyperspectral images, morphodynamic evolution, coastal zone

Brief Description:

This project proposes to investigate new methods for the analysis of data acquired through remote sensing techniques for monitoring coastal morphological evolution. The objective is to use satellite data (or other aerial vectors) to obtain accurate and detailed information on the variation of coastal morphological characteristics over time, in particular bathymetry and coastline.

The first phase of the project includes an in-depth literature search to define the state of the art in the international community, to define open issues and to determine an operational workflow.

The main focus will then be on the analysis of multi/hyperspectral optical images, with the integration of environmental parameters acquired by satellite, such as temperature, chlorophyll concentration or suspended sediment, and data from active sensors such as Lidar and Synthetic Aperture Radar.

Analysis methodologies will rely on techniques such as Machine Learning and Artificial Intelligence tools, assessing their replicability, accuracy and precision of results.

In addition, field data will be acquired using vessels and hydro-oceanographic instrumentation to validate and improve the results obtained.

Referent: Bianca Federici, bianca.federici@unige.it

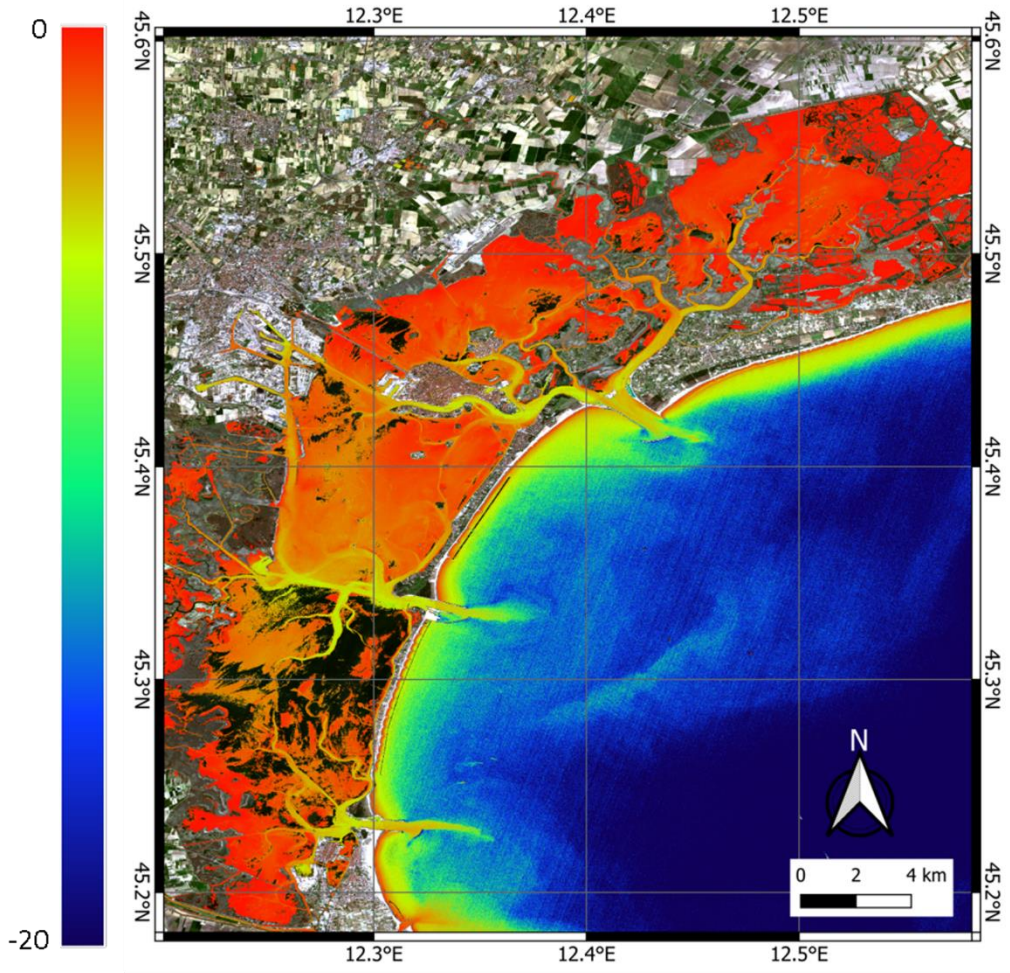
Relevant links:

Bernardis M, Nardini R, Apicella L, Demarte M, Guideri M, Federici B, Quarati A, De Martino M. Use of ICEsat-2 and Sentinel-2 Open Data for the Derivation of Bathymetry in Shallow Waters: Case Studies in Sardinia and in the Venice Lagoon. Remote Sensing. 2023; 15(11):2944. https://doi.org/10.3390/rs15112944.

Apicella L, De Martino M, Ferrando I, Quarati A, Federici B. Deriving Coastal Shallow Bathymetry from Sentinel 2-, Aircraft- and UAV-Derived Orthophotos: A Case Study in Ligurian Marinas. Journal of Marine Science and Engineering. 2023; 11(3):671. https://doi.org/10.3390/jmse11030671

Magrì, S., Ottaviani, E., Prampolini, E., Besio, G., Fabiano, B., Federici, B. Application of machine learning techniques to derive sea water turbidity from Sentinel-2 imagery. Remote Sensing Applications: Society and Environment, 2023, 30, 100951.
https://www.sciencedirect.com/science/article/pii/S2352938523000332

Figure:



Courtesy of Bernardis M, Nardini R, Apicella A, Demarte M, Guideri M, Federici B, Quarati A & De Martino M.

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Project: Operational tools for dredging management: from legislative framework to environmental management.

Keywords: Dredging, Sediment Transport, Turbidity, Environmental Coastal Management

Brief Description: The project aims to define and analyze, based on legislative, environmental and technical aspects, the dredging project and monitoring plan applicable to the planned activities of the Armed Force. The studies should allow the definition, according to regulatory dictates, of monitoring plans. The project development program should define the environmental framework of the area under consideration, define potentially sensitive targets, and identify monitoring stations in order to calibrate the monitoring strategy. Develop a comparison of possible mathematical models related to turbidity dispersion during dredging operations. Define the frequency of monitoring for the phases of the work cycle of the program identified in consultation with the Armed Force, in order to develop and recommend mitigation and additional safety measures and emergency procedures. The project is carried out in collaboration with Marina Militare

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Relevant links: meteocean.science

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Project: Hindcasting and forecasting the triggering and dynamics of marine sediment gravity flows

Keywords: sediment gravity flows, turbidity currents, sediment transport, submarine geohazard, numerical modelling

Brief Description:

The aim of this PhD fellowship is to study the factors influencing the initiation and behaviour of sediment-laden gravity flows developing over the seabed and in reservoirs. Although recent advances in direct monitoring techniques have provided valuable information on the structure and duration of these extreme currents, our understanding of their underlying causes and dynamics is still limited. The research proposal focuses on the study of the conditions that lead to the formation of hyperpycnal flows (mixtures of water and sediment that are therefore denser than the surrounding marine environment) at the edge of the continental shelf and their transformation into turbid currents (submarine currents of water and sediment that can be likened to avalanches) along the continental slope and in artificial or natural lakes.

The project involves the development of various numerical models. These models will aim to accurately simulate the transport of both cohesive and non-cohesive sediments caused by meteo-marine forcing at shallow depths, the transport of bottom sediment mixtures, and the associated movement of bottom forms caused by turbid seabed currents. Initially, numerical simulations will be conducted to reproduce results from laboratory experiments, the data from which will be used to calibrate and validate the numerical models.

Once the numerical applications at the laboratory scale have been validated, they will be extended and applied to real cases of turbid currents whose velocities and densities have been recently monitored and associated with seabed surveys that show the trace of the transit of these currents. Through the analysis of these case studies, the research aims to improve our understanding of the main factors influencing the dynamics of turbid currents, including their initiation and frequency. In addition, the study will help assess the risks that the impact of these flows might pose on seabed infrastructure, telecommunication or power cables, and clarify their role in global carbon and sediment cycles.

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Relevant links: www.weatherwatersand.com

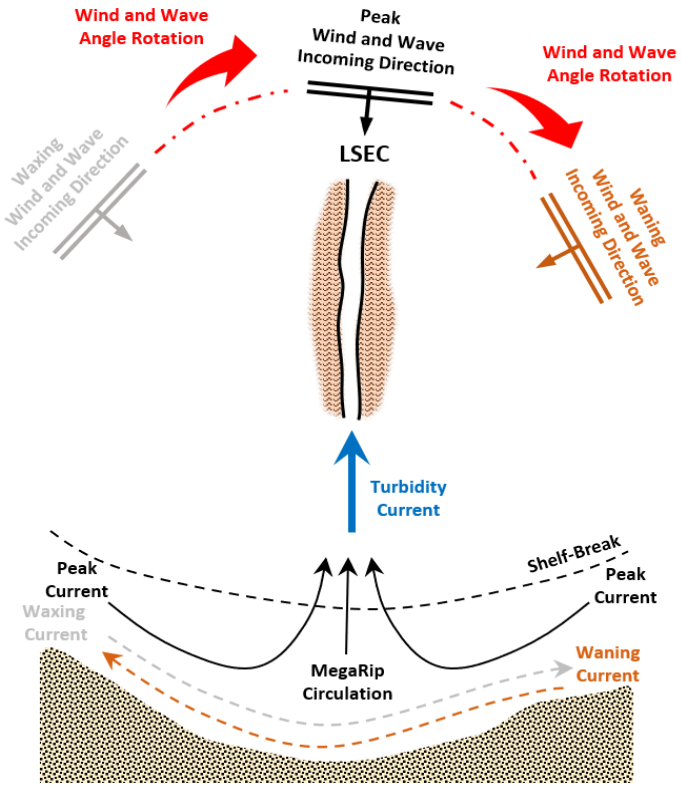

Figure: Schematics of alongshore currents inducing megarip circulation and the triggering of a turbidity current along a submarine canyon (from Porcile et al., 2023)