



UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Coastal Risks and Dynamics

2526-2-F7502Q023

Aims

The course aims to equip students with knowledge of coastal processes and risks that influence coastal dynamics and evolution in a changing climate. Students will also develop the skills necessary to acquire and process geospatial data, which are essential for mapping and monitoring the evolution of coastal environments over time, utilising cutting-edge technologies and advanced processing techniques.

By the end of the course, students should be able to understand and assess the physical coastal system, identify coastal vulnerabilities and risks (DdD1), and evaluate potential defence policies within the framework of Integrated Coastal Zone Management (ICZM) (DdD1).

The course will also enable students to assess human activities and interventions in nearshore environments within anthropized areas (DdD2), and to represent these elements on maps derived from field-collected data (DdD2, DdD5).

The final assessment will focus on students' ability to organize and present scientific data, thereby strengthening their communication skills (DdD4), as well as their capacity to independently analyze data and produce clear, well-structured reports (DdD5).

Contents

The course aims to provide a basic understanding of hydrodynamic (wave genesis and transformation) and morphodynamic (sediment transport, beach profile evolution, and coastline dynamics) processes induced by natural and anthropogenic pressures, and to evaluate design tools for preventing and mitigating coastal risks related to beach erosion, flooding, and extreme events.

Detailed program

The main topics covered during the ** lectures of frontal teaching (delivered didactic)** include:

- The coastal zone.
- Wind waves - Wave theories - Wave transformation from offshore to onshore.
- Sea level. Astronomical tide. Wave set-down and wave set-up. Wave run-up. Longshore, rip and undertow currents.
- The beach. Sediment characteristics. Cross-shore beach profile. Equilibrium beach profile. Closure depth. The concept of physiographic region. Sediments balance.
- Coastal Dynamics and processes. Sediment transport. Long-shore and cross-shore sediment transport. Shoreline evolution. Prediction of shoreline evolution. Elements of beach-dune system morphodynamics.
- Coastal risk. Coastal erosion: natural and anthropogenic pressures.
- Resilience and resistance of coastal systems.
- Coastal vulnerability.
- Climate change and extreme events: storm surges, flooding, typhoons, tsunami.
- Sea level rise projections, Risk assessment and Coastal protection systems.
- Nourishments and coastal sand dune restoration with eco-friendly techniques.
- Elements of coastal management policies. Elements of marine renewable wind and wave energy

Practical activities carried out **during laboratory hours include:**

- Satellite Remote Sensing for Shoreline Change Detection: Use time-series satellite imagery (Sentinel-2, Landsat) to analyze shoreline dynamics
- Processing Drone Imagery for Coastal Monitoring: Introduce photogrammetry for coastal surveying using drone images
- Coastal Risk Mapping with Multi-Criteria GIS Analysis: Perform risk zoning based on physical and socio-economic layers

There will be a dedicated field trip at the end of the course (1 day - 2 nights). This trip will involve using some of the instruments studied in the tutorials, including aerial drones, GeoSLAM (portable laser scan), GPS, and GNSS base stations, and collecting data on coastal environments using the described methodologies. The field trip will be conducted in La Spezia Gulf using the scuola di Mare Santa Teresa - Smart Bay - Lerici as a field base station (<https://scuoladimare.com/>). **The participants need to reach the location independently, and it may be necessary to pay for accommodation on a full-board basis (approximately 70€ per night).**

Prerequisites

Basic knowledge of marine geomorphology and GIS environments

Teaching form

- **4 Credits CFU of delivered didactics:** 14 two-hour lectures, in person, Delivered Didactics
- **1 Credit CFU of laboratory activity:** 4 three-hour lab activities, in person, Interactive Teaching
- **1 Credit CFU of field activity (Campus abroad):** 1 twelve-hour (2 days) field activity, in person, Interactive Teaching

Textbook and teaching resource

Slides, scientific articles and self-assessment test on the e-learning page of the course

Suggested textbooks:

Davidson-Arnott R., Bauer B., Houser, C. (2019) Introduction to coastal process and geomorphology. Cambridge University Press

Coastal Systems: Third Edition Haslett, Simon K. Published by University of Wales Press, 2016 ISBN 10: 1783169001****

Semester

First Semester

Assessment method

The assessment will be a combination of:

- **Oral presentation** at the end of the practical classes, to assess: the acquired knowledge, the ability to choose the most important data related to a case study, the ability to communicate in a specific scientific language, proper for the course.
- **A report on the practical laboratory activities** to evaluate the understanding gained, the ability to analyse the dataset, and the methodology used for creating thematic maps. It must be submitted at least four days prior to the oral examination.

During the exam, the teacher will assess the student's knowledge of the relevant course material, their ability to connect information from different sources, and their capacity to clearly explain the course topics using appropriate terminology. *Grades are out of 30, with a minimum passing score of 18.*

The final grade will be calculated from the average of the final laboratory report, the students' performance in laboratory activities, and the results of the oral test.

Office hours

Please feel free to send an email to arrange an appointment: luca.fallati@unimib.it

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Sustainable Development Goals

INDUSTRY, INNOVATION AND INFRASTRUCTURE | CLIMATE ACTION

