

# UNIVERSITÀ DEGLI STUDI DI MILANO-BICOCCA

## **COURSE SYLLABUS**

## **Geo-Hydrological Risk**

2324-1-F7401Q109

## **Module description**

General introduction to the hydrosphere and fluids

- Water on Earth; oceans, glaciers, rivers, lakes; groundwater and atmosphere
- Rivers and canals: basic principles, canal types, erosion, transport and sedimentation
- River dynamics and hydraulics. Chezy equation, Manning equation and other speed-slope relationships
- Sedimentary transport (\*)

Statics and dynamics of fluids: basics

- Introduction to fluid dynamics
- Equation of conservation of momentum applied to fluids; Navier-Stokes and continuity equations (\*)
- Newtonian and non-Newtonian fluids
- Rheology
- · Applications to natural hazards

Introduction to landslides and their dynamics

- Types of landslides and mass movements (outline)
- Notes on slope stability; triggering factors (\*)
- Introduction to granular materials
- Equations of motion: from sliding rigid bodies to granular materials
- Introduction to rock avalanches
- Case studies on rock avalanches

#### The debris flows

- Hyper-concentrated flows
- Rheology of debris flows
- Dynamics of debris flows
- Examples and case studies
- Special cases: lahar, GLOF, quick clay
- Numerical modeling of castings (\*)

· Case studies on debris flows

Other hydrogeological risks related to closed basins and rivers

- Flooding
- Breaking of large dams
- Physical modeling of catastrophic waves in hydrological basins; de-Saint Venant equation (\*)
- Landslides in large hydroelectric basins and lakes
- Study cases

Other hydrogeological risks related to seas and oceans

- Coastal dangers (\*)
- Submarine landslides: generation and propagation
- Tsunami: generation, risk
- Physics of tsunamis; waves in shallow water; dispersion relations; diffraction and propagation of tsunami waves, run-up on land
- Study cases

Risks related to snow and ice (\*)

- Introduction to snow and ice
- Glaciers: flow, dynamics, balance
- Snow avalanches: types, description, and formation
- Dynamics of snow avalanches
- Ice avalanches; collapsing glacial fronts; seracs; hanging glaciers
- Ice-climate relationship in glaciers
- Study cases

#### Epilogue

- Defense strategies (notes)
- Extreme catastrophes in the history of the Earth and of humanity also in relation to the climate ()
- Extreme global events in the future ()

## Learning goals

Elements of hydrogeological risks, with some quantitative insights into the risks caused by water on continents and in the oceans

## **General goal**

Specific skills and competences

Sustainable Development Goals of the 2030 UN Agenda

### Breakdown of meetings

2 hours-meetings

3
Language used in meetings
Italian and English
Delivery period of the module
Second Semester
Methods of assessing the outcomes of the learning process
Modalità esame
<ul> <li>Esame scritto intermedio</li> <li>Esame basato su esercizi e esposizione scritta e eventualmente colloquio</li> </ul>
Department of affiliation of the teacher
DISAT

Number of participants

**Sustainable Development Goals** 

QUALITY EDUCATION