Course guide
250583 - MPRRIGEZCO - Prediction and Risk Models for the Management of the Coastal Zone

Unit in charge: Barcelona School of Civil Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering.
Degree: BACHELOR’S DEGREE IN MARINE SCIENCE AND TECHNOLOGY (Syllabus 2018). (Optional subject).
Academic year: 2022 ECTS Credits: 6.0 Languages: Spanish

LECTURER

Coordinating lecturer: JOSE ANTONIO JIMENEZ QUINTANA
Others: MANUEL ESPINO INFANTES, DANIEL GONZALEZ MARCO, VICENTE GRACIA GARCIA, JOSE ANTONIO JIMENEZ QUINTANA, JUAN PABLO SIERRA PEDRICO

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
13388. To know and apply the lexicon and concepts of the Marine Sciences and Technologies and other related fields.
13390. Establish a good practice in the integration of common numerical, laboratory and field techniques in the analysis of any problem related to the marine environment.
13391. Participate and eventually lead multidisciplinary work teams in the field of Marine Sciences and Technologies to respond to the social challenges related to this field.
13392. Evaluate the bio- and geo-diversity of the marine environment, identifying habitats and ecosystems with multidisciplinary criteria.
13393. Evaluate the dynamics of seas and oceans at different scales, identifying water masses and their properties. (Specific competence of Marine Science and Engineering Mention)
13394. Address the most relevant processes and their interactions related to their physical / chemical / biological / geological components, applying technical and scientific knowledge and criteria.
13396. To set, analyze and optimize the functionality of actions and infrastructures in the marine environment. (Specific competence of the Marine Science and Engineering Mention)
13397. Carry out operational predictions in the open sea and coastal areas, including the corresponding risk maps. (Specific competence of the Marine Science and Engineering Mention)
13400. Use state-of-the-art mathematical models in the marine field to analyze impacts and interactions with socio-economic activities supported by this environment. (Specific competence of the Marine Science and Engineering Mention)
13403. Develop a conceptual framework to address the sustainability of the marine environment and the related socio-economic activities at different scales, explaining the effects of climate change.
13404. Set, plan and execute basic and applied research in the field of Marine Sciences and Technologies.
13405. Carry out calculations, assessments, surveys and inspections in coastal and marine environments, as well as the corresponding technical documents.
13406. Write technical reports and disseminate knowledge about the different components of the marine system, considering the applicable legal framework.
13407. Apply the necessary tools to analyze the economic and legal aspects of human actions and the related impacts on the marine environment, including technical advice and representation of companies and administrations.
Generical:
13382. Apply state-of-the-art methods and techniques in oceanography and marine climate, jointly covering the physical, chemical, geological and biological aspects.
13383. Develop a conceptual framework that links the scientific-technological and management aspects for marine resources, explaining the interactions with marine infrastructures and management plans in coastal areas.
13386. Encompass and teach studies in the different research lines that converge in Marine Sciences and Technologies.
13387. Combining preservation with economic activity within the framework of current legislation promoting the development of a social and environmental awareness.

TEACHING METHODOLOGY

The course consists of 4 hours a week of face-to-face classes in a classroom.

It will be organized in thematic blocks in which approximately 50% of the time will be devoted to theoretical/practical classes, in which the teachers present the concepts, basic materials of the subject, tools to use and present examples and perform exercises.

The rest of the time will be dedicated to the use of common techniques and tools in risk analysis from a practical point of view. Specific exercises will be carried out with a greater participation of the students in order to consolidate the learning objectives.

Throughout the course, approximately 6 hours will be dedicated to carrying out the assigned course work under the supervision of the teaching staff.

Support material will be used in the format of a detailed teaching plan through the virtual campus ATENEA: contents, programming of evaluation and directed learning activities and bibliography.

Note: The language in which the classes will be given will depend on the teacher. Specifically, professors Jose Jimenez and Manuel Espino will teach their classes in Spanish, professors Joan P Sierra and Vicenç Gracias in Catalan.

Although most of the sessions will be given in the language indicated, sessions supported by other occasional guest experts may be held in other languages.

LEARNING OBJECTIVES OF THE SUBJECT

In this subject, aspects related to vulnerability and hazard assessment and risk mapping in coastal areas under extreme events of rain, wind, waves and sea level will be addressed. From here, forecasting methodologies for these coastal events will be shown, using data assimilation and numerical modeling, with the purpose of supporting management decision-taking. Emphasis will be placed on urban beaches, coastal and port defences and infrastructures of coastal cities.

1. Establish the concepts of risk, vulnerability and danger applied to the coastal zone.
2. Use of computational and operational tools for the analysis of coastal risks and evaluation of possible solutions
3. Characterization of the complexity of the coastal zone due to its interdisciplinary nature, different uses, conflicts and threats
4. Know and use available tools for coastal planning and management, based on the modeling and analysis of complex spatial relationships (GIS, Marine GIS, etc ...).

The topics addressed in this matter cover most of the physical, environmental and ecological problems and challenges identified by the scientific community and the social agents that the coastal zone will face in the near future under different development scenarios and climate change.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Hours small group</td>
<td>15.0</td>
<td>10.00</td>
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<tr>
<td>Self study</td>
<td>84.0</td>
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<td>Hours medium group</td>
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<td>Type</td>
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<tr>
<td>Guided activities</td>
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<td>4.00</td>
</tr>
<tr>
<td>Hours large group</td>
<td>30,0</td>
<td>20.00</td>
</tr>
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**Total learning time:** 150 h

**CONTENTS**

**Introduction**

**Description:**
Introduction to the course
Presentation of the key concepts related to coastal risk. Definitions
Individual and collective assessment of the main types of coastal risks

**Specific objectives:**
Course structure. Sources of information and data. Practical work.
Presentation and definition of the key concepts related to coastal risk analysis.
Identification and initial assessment of the importance of the main types of coastal risks by the students of the class. Assessment of the initial perception of risk in general, and of the Catalan coast in particular.

**Full-or-part-time:** 9h 36m
Theory classes: 3h
Practical classes: 1h
Self study : 5h 36m

**Coastal risks in the Mediterranean**

**Description:**
Identification and description of the main risk factors that induce coastal risk.
Characterization of the main elements (population, uses, natural resources, infrastructures, etc.) that determine the magnitude of the damage along the coast.
Forecasting future changes in coastal risk

**Specific objectives:**
Put the agents that induce coastal risk in the Mediterranean in a global context.
Identify the different components that contribute to the value of the coastline and that will determine the magnitude of the potential damage.
Present the main expected changes in coastal risk in the Mediterranean and identify the factors that determine them

**Full-or-part-time:** 9h 36m
Theory classes: 4h
Self study : 5h 36m
Preliminary assessment of coastal risk and vulnerability to multiple large-scale agents

Description:
Large-scale coastal vulnerability and risk assessment methods using the CSI / CVI approach. 
Presentation of the Coastal Wheel method for preliminary assessment of coastal risk on a very large scale 
Application of the methods seen in a real case. Comparison of results according to the chosen method.

Specific objectives:
Present the main methods for assessing coastal vulnerability and risk on a large scale using composite indices. 
Introduce a very large scale preliminary risk analysis method that is valid even in data-poor situations. 
Become familiar with the use of the tools seen in the topic.

Full-or-part-time: 9h 36m 
Theory classes: 2h 
Laboratory classes: 2h 
Self study : 5h 36m

Risk of erosion

Description:
Identification of the factors that determine coastal erosion at different scales. Using the SPRC analysis framework 
Medium and long term erosion 
Quantification of coastal erosion during storms 
Geomorphological vulnerability and resilience. Assessment of consequences 
Evaluation of the coastal risk of erosion in a coastal stretch

Specific objectives: 
Introduce main characteristics of erosion during storms and evaluation methods

Full-or-part-time: 16h 48m 
Theory classes: 5h 
Practical classes: 2h 
Self study : 9h 48m

Flood risk

Description:
Coastal flooding during storms 
Long-term flooding. The effect of sea level rise 
Compound flooding 
Vulnerability and consequences. 
Flood modeling 
Flood risk analysis in a coastal stretch

Full-or-part-time: 16h 48m 
Theory classes: 4h 
Practical classes: 2h 
Laboratory classes: 1h 
Self study : 9h 48m
## Coastal risk assessment frameworks for the impact of extreme events

**Description:**
The Coastal Risk Assessment Framework (CRAF)
Risk estimation using CRAF in a stretch of real coast
Risk prediction using nested models
Forecast system for the impact of storms

**Full-or-part-time:** 19h 12m
Theory classes: 3h 30m
Practical classes: 2h
Laboratory classes: 2h 30m
Self study: 11h 12m

## Evaluation

**Full-or-part-time:** 14h 23m
Laboratory classes: 6h
Self study: 8h 23m

## Risks associated with water quality

**Description:**
Main risk factors for pollution in the coastal zone
Pollutant dispersion models
Oil pollution
Plastic pollution
Numerical modeling of oil pollution
Practice: model of plastics in the sea

**Full-or-part-time:** 21h 36m
Theory classes: 3h
Practical classes: 4h
Laboratory classes: 2h
Self study: 12h 36m

## Other risks

**Description:**
Tsunamis
Risks to safety on beaches

**Full-or-part-time:** 7h 11m
Theory classes: 3h
Self study: 4h 11m
**Risk management**

**Description:**
- Risk management strategies
- Perception of risk. The social component
- Measures for erosion risks
- Measures for flood risks
- Nature-oriented measures
- Risk management and ICZM
- Proposal of risk management measures for real cases

**Full-or-part-time:** 19h 12m
- Theory classes: 6h
- Practical classes: 2h
- Self study: 11h 12m

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**GRADING SYSTEM**

The mark of the course is obtained from the qualifications of the tutored course work (30%) and two specific evaluation tests (35% each one).

The tutored course work consists of applying the concepts and tools covered during the course to assess the risk in a coastal area to be determined. Normally it will be in a part of the Spanish coast (to facilitate access to real data), although it can be done in any area depending on data availability. It requires team work, the preparation of a written report and a final public presentation.

Specific evaluation tests consist of a part with questions on concepts associated with the learning objectives of the course in terms of knowledge or understanding, and a set of application exercises.

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**EXAMINATION RULES.**

If any of the proposed activities or continuous assessment is not carried out in the scheduled period, it will be considered as a zero score.

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**BIBLIOGRAPHY**

**Basic:**