Course guide
250582 - CCIMPMMAZC - Climate Change. Impacts in the Marine Environment and 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: Catalan

LECTURER

Coordinating lecturer: AGUSTIN SANCHEZ-ARCILLA CONEJO
Others: CORRADO ALTOMARE, MANUEL ESPINO INFANTES, ALBERT FOLCH SANCHO, MARIA LISTE MUÑOZ, JUAN PEDRO MARTÍN VIDE, AGUSTIN SANCHEZ-ARCILLA CONEJO, XAVIER SÁNCHEZ ARTÚS

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)
13398. 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.

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 2.3 hours per week of classroom activity (large size group) and 1.2 hours weekly with half the students (medium size group).

The 2.3 hours in the large size groups are devoted to theoretical lectures, in which the teacher presents the basic concepts and topics of the subject, shows examples and solves exercises.

The 1.2 hours in the medium size groups is devoted to solving practical problems with greater interaction with the students. The objective of these practical exercises is to consolidate the general and specific learning objectives.

The rest of weekly hours devoted to laboratory practice.

Support material in the form of a detailed teaching plan is provided using the virtual campus ATENEA: content, program of learning and assessment activities conducted and literature.

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, basic aspects of Climate Change at a global scale will be addressed (considering the future scenarios described by the IPCC), and its impact at a regional coastal scale. Emphasis will be placed on the main factors of change at the coast, such as the variation of the mean sea level, the distribution of extreme wave, wind and rain events, water temperature and its relation to acidification. Finally, the most relevant aspects of the impact on the coasts and ports and, in general, on the planning of the coastal zone will be addressed.

1. Understand the anthropogenic causes of climate change. Understand the different projections presented in the IPCC reports.
2. Understand the impact of climate change on marine and coastal systems from an ecological, physical and human point of view.
3. Become familiar with the most common methods to mitigate the effects of climate change on the coast, and potential adaptation techniques, both natural and assisted.

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.

* Introduce vocabulary and concepts used in the analysis of climate change. * Analyze the basis and present dynamics of the marine and coastal environment to be able to evaluate the climatic impact. * Participate in multi-disciplinary work teams, made up of students with different curricular itineraries and led by teachers with different skills to respond to the challenges posed by climate change. * Evaluate the multiple dimensions of the impact on the marine and coastal environment with multi-disciplinary criteria. * Address the most relevant scales and processes that determine the physicochemical, biological-geological and socio-economic components of climate change over the coastal zone. * Pose and analyze possible interventions for an adaptation of the coastal zone together with the adjacent marine and terrestrial strip and thus achieve greater sustainability under climate change. * Use data and models to calculate the impacts of climate change on marine and coastal areas and possible adaptation measures. * Develop a conceptual framework to structure the actions of adaptation to time scales ranging from storms to decades and space scales ranging from a coastal ecosystem to a regional analysis of the marine environment (terrestrial, coastal and platform) under different climatic scenarios. * Possess an integrated perspective of the different tools and technologies of calculation to determine impacts and paths of adaptation to the climatic change to marine and coastal zones. * Improve the ability to write reports and present analyzes on the impact of climate change on marine and coastal areas.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Hours medium group</td>
<td>15,0</td>
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<tr>
<td>Hours small group</td>
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<tr>
<td>Guided activities</td>
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</tr>
<tr>
<td>Self study</td>
<td>84,0</td>
<td>56.00</td>
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</table>
## CONTENTS

### 1. Introduction to climate change in environments coastal

**Description:**
Presentation of the structure

**Specific objectives:**
Introduction to climate change in coastal environments
Present the models for the hydro-morphodynamic analysis of beaches and the possible calculation of the impacts of different actions. Familiarize students with models under present conditions and explore the effect of future scenarios.

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

### 2. Meteo-oceanographic factors. Sea level and swell

**Description:**

**Specific objectives:**
Familiarize the student with the meteo-oceanographic factors under present and future conditions and their interactions, with emphasis on their impact on natural systems and coastal and port infrastructures.

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

### 3. Meteorographic factors. Analysis with real data

**Description:**

**Specific objectives:**
Carry out a practical analysis of the variability of meteorological and oceanographic factors relevant to pacts in ports and beaches. Compare differences under present and future conditions.

**Full-or-part-time:** 9h 36m
Practical classes: 4h
Self study: 5h 36m
4. Geological factors. Topography and bathymetry of the Catalan coast

Description:
Tectonic variations and average sea level. Subsistence in deltaic areas. Applications on the Catalan coast. Variation of bathymetry and topography and consequences for impacts. Coupling due to meteorological forcing associated with topo-bathymetry. Variations in the active profile of the beach and monitoring of a dynamic topography.

Specific objectives:
Familiarize the student with how geological factors condition the impact of climate change on natural systems and infrastructures in the coastal area, with special emphasis on the Catalan coast.

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

5. Continental contributions and river-delta-sea connection on the Catalan coast. The case of the river Ebro

Description:
Present the connection between the continent and the maritime area, especially the coast, in terms of water flows, sediments, nutrients and pollutants under present and future conditions, considering the interactions with the different existing infrastructures and/or plan.

Specific objectives:
Present the connection between the continent and the maritime area, especially the coast, in terms of water flows, sediments, nutrients and pollutants under present and future conditions, considering the interactions with the different existing and/or planned infrastructures.

Full-or-part-time: 4h 48m
Theory classes: 2h
Self study: 2h 48m

Continental contributions and river-delta-sea connection on the Catalan coast. The case of the Llobregat river

Description:

Specific objectives:
Present the connection between the continent and the maritime area, especially the coast, in terms of water flows, sediments, nutrients and pollutants under present and future conditions, considering the interactions with the different existing and/or planned infrastructures.

Full-or-part-time: 4h 48m
Theory classes: 2h
Self study: 2h 48m
### 7. Coastal aquifers, with exchange and salinization flows under present and future climatic scenarios

**Description:**

**Specific objectives:**
Present the connection between the continent and the maritime area, especially the coast, in terms of water flows, sediments, nutrients and pollutants under present and future conditions, considering the interactions with the different existing and/or planned infrastructures.

**Full-or-part-time:** 9h 36m  
Theory classes: 4h  
Self study: 5h 36m

### 9. Hydro-morphodynamic modeling of real beaches under present and future conditions

**Description:**

**Specific objectives:**
Develop practical applications of hydrodynamic and morphodynamic models for beaches typical of the Catalan coast, considering the differences under present and future conditions.

**Full-or-part-time:** 19h 12m  
Practical classes: 8h  
Self study: 11h 12m

### 10. Early warning systems and their technical evolution under present and future climatic conditions

**Description:**
Coastal early warning systems available. Applications to port cases. Applications to beach cases. Thresholds for present conditions. Thresholds for future conditions. Extrapolation of the modeling under future conditions.

**Specific objectives:**
Introduce the available coastal early warning systems and plan their evolution based on technical advances and future climate scenarios, based on real examples of our coast.

**Full-or-part-time:** 9h 36m  
Theory classes: 4h  
Self study: 5h 36m

### 11. Approach of the course work

**Description:**
Program for the elaboration of the course work. Elaboration of groups. Assignment of topics Evaluation criteria.

**Specific objectives:**
Elaboration of a group course work

**Full-or-part-time:** 4h 48m  
Theory classes: 2h  
Self study: 2h 48m
12. Concepts of sustainable development for marine and coastal areas under present scenarios

Description:

Specific objectives:
Present the concepts of sustainable development for coastal areas, analyzing their application for different types of coast and port infrastructures.

Full-or-part-time: 4h 48m
Theory classes: 2h
Self study: 2h 48m

13. Adaptation tools for low coasts (deltas / estuaries) and artificial ones. Concepts and models

Description:

Specific objectives:
Present the concept of adaptation route and its temporal evolution depending on the interventions that are carried out. Also present the concepts of limit points and their application to different coastal and port cases on our coast.

Full-or-part-time: 9h 36m
Theory classes: 4h
Self study: 5h 36m


Description:

Specific objectives:
To generalize the concept of adaptation routes for coastal infrastructures, mainly ports but also including promenades. Illustration with cases of the Catalan coast.

Full-or-part-time: 9h 36m
Theory classes: 4h
Self study: 5h 36m

15. Practice 3 Numerical modeling for the adaptation of dikes to climate change. Functional analysis and resis

Description:

Specific objectives:
Develop a practical application of models for the functional and resilient analysis of dikes under present and future conditions, comparing the differences in impact and the limits of the models.

Full-or-part-time: 9h 36m
Practical classes: 4h
Self study: 5h 36m
16. Presentation of the course work

**Full-or-part-time:** 4h 48m  
Laboratory classes: 2h  
Self study: 2h 48m

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**GRADING SYSTEM**

The mark of the course is obtained from the ratings of continuous assessment and their corresponding laboratories and/or classroom computers.

Continuous assessment consist in several activities, both individually and in group, of additive and training characteristics, carried out during the year (both in and out of the classroom).

The teachings of the laboratory grade is the average in such activities.

The evaluation tests consist of a part with questions about concepts associated with the learning objectives of the course with regard to knowledge or understanding, and a part with a set of application exercises.

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**EXAMINATION RULES.**

Continuous assessment during the development of the classes and public presentation of the course work developing in group.

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**BIBLIOGRAPHY**

**Basic:**

**Complementary:**