Prediction and Risk Models for the Management of the Coastal Zone (250583)

General Information

School	ETSECCPB
Departments	Departament d'Enginyeria Civil i Ambiental (DECA)
Credits	6.0 ECTS
Programs	GRAU EN CIÈNCIES I TECNOLOGIES DEL MAR (pla 2018)
Course	2024/25

Main teaching language at each group

- Group 10ES1 Spanish (Q1)

Faculty

Responsible Faculty: Jose Antonio Jimenez Quintana
Faculty: Jose Antonio Jimenez Quintana, Marc Mestres Ridge, Juan Pablo Sierra Pedrico

Objectives of Education

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.

Competencies

Especific

To know and apply the lexicon and concepts of the Marine Sciences and Technologies and other related fields.
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.
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.
Evaluate the bio- and geo-diversity of the marine environment, identifying habitats and ecosystems with multidisciplinary criteria.
Evaluate the dynamics of seas and oceans at different scales, identifying water masses and their properties. (Specific competence of Marine Science and Engineering Mention)

Address the most relevant processes and their interactions related to their physical / chemical / biological / geological components, applying technical and scientific knowledge and criteria.
To set, analyze and optimize the functionality of actions and infrastructures in the marine environment. (Specific competence of the Marine Science and Engineering Mention)
Carry out environmental impact, management and protection studies of the marine environment and adjacent coastal areas, including the corresponding infrastructures and their related impacts.
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)
Use state-of-the-arte 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)
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.
Set, plan and execute basic and applied research in the field of Marine Sciences and Technologies.
Carry out calculations, assessments, surveys and inspections in coastal and marine environments, as well as the corresponding technical documents.
Write technical reports and disseminate knowledge about the different components of the marine system, considering the applicable legal framework.
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.

Generic

Apply state-of-the-art methods and techniques in oceanography and marine climate, jointly covering the physical, chemical, geological and biological aspects.
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.
Encompass and teach studies in the different research lines that converge in Marine Sciences and Technologies.
Combining preservation with economic activity within the framework of current legislation promoting the development of a social and environmental awareness.

Total hours of student work

		Hours	Percentage
Supervised Learning	Large group	30.0 h	50.00 %
	Medium group	15.0 h	25.00 %
	Laboratory classes	15.0 h	25.00 %
	Guided Activities	0.0 h	0.00 %
Self Study		90.0 h	

Contents

Introduction

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.

Coastal risks in the Mediterranean

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

Preliminary assessment of coastal risk and vulnerability to multiple large-scale agents

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.

Risk of erosion

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

Flood risk

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

Coastal risk assessment frameworks for the impact of extreme events

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

Evaluation

Risks associated with water quality

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

Other risks

Tsunamis
Risks to safety on beaches

Risk management

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

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.

Grading Rules

(*) The evaluation calendar and grading rules will be approved before the start of the course.

La qualificació de l'assignatura s'obté a partir de les qualificacions del treball de curs (30%) i de dues proves específiques d'avaluació (35% cadascuna).

El treball de curs dirigit consisteix a aplicar els conceptes i eines vistes durant el curs per a avaluar el risc en una zona costanera a determinar. Normalment serà en una part de la costa espanyola (per a facilitar l'accés a dades reals), encara que es podrà realitzar en qualsevol zona en funció de les dades disponibles. Requereix treball en equip, la preparació d'un informe escrit i una presentació final en públic.

Les proves específiques d'avaluació consten d'una part amb qüestions sobre conceptes associats als objectius d'aprenentatge de l'assignatura quant al coneixement o la comprensió, i d'un conjunt d'exercicis d'aplicació.

Re-avaluació (RE)
Criteris de qualificació i d'admissió a la reavaluació (Re):

Els alumnes suspesos a l'avaluació ordinària que s'hagin presentat regularment a les proves d'avaluació de l'assignatura suspesa tindran opció a realitzar una prova de reavaluació en el període fixat en el calendari acadèmic. No podran presentar-se a la prova de reavaluació d'una assignatura els estudiants que ja hagin superat ni els estudiants qualificats com no presentats o que no hagin lliurat la totalitat dels treballs i informes.

La reavaluació (RE) consistirà en un únic examen que abasta tot el contingut del curs. La nota màxima de la reavaluació serà de cinc (5.0) i la nota final del curs serà la nota màxima entre l'avaluació continuada i l'examen de re-avaluació, és a dir, MAX(Evaluació/RE).

La no assistència d'un estudiant convocat a la prova de reavaluació, celebrada en el període fixat no podrà donar lloc a la realització d'una altra prova amb data posterior. Es realitzaran avaluacions extraordinàries per a aquells estudiants que a causa de força major acreditada no hagin pogut fer alguna de les proves d'avaluació continuada. Aquestes proves han de ser autoritzades pel cap d'estudis corresponent, a petició del professor responsable de l'assignatura, i es realitzaran dins del període lectiu corresponent.

Test 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.

Office Hours

Consultation hours to be agreed with the teachers of the subject (between 08:00 and 16:00)

Bibliography

Basic

- Kim, Y.C. Handbook of coastal and ocean engineering. Hackensack ; London: World Scientifc, 2010. ISBN 9789812819291.
- Penning-Rowsell, E., Priest, S., Parker, D., Morris, J., Tunstall, S., Viavattene, C., Chatterton, J., Owen, D. Flood and coastal erosion risk management: a manual for economic appraisal. Routledge, 2013. ISBN 9780415815154.
- Doerffer, J.W. Oil spill response in the marine environment. Oxford: Pergamon Press, 1992. ISBN 0800410006.