UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH

R&D IN WATER, MARINE AND MARITIME RESOURCES AT THE UPC

2024

Generalitat de Catalunya

Cofinançat per la Unió Europea

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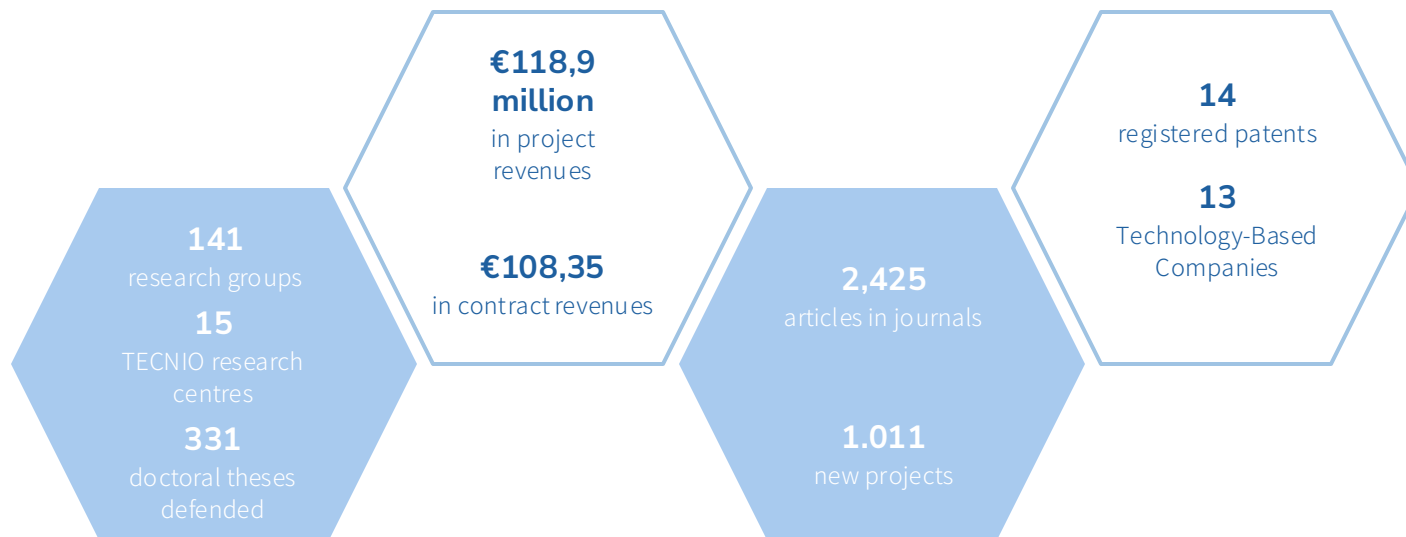
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01 THE UPC

The Universitat Politècnica de Catalunya – BarcelonaTech (UPC) is a public university dedicated to research and higher education in the fields of engineering, architecture, sciences and technology. It has a significant presence and active involvement in the industrial centres of the region.
The UPC actively participates in Catalonia's innovation system through
research projects, contracts, knowledge valorisation and technology commercialisation efforts that address significant social challenges.

RESEARCH, DEVELOPMENT AND INNOVATION ACTIVITY AT THE UPC
2023

€118,9 million
in project revenues

€108,35
in contract revenues

141
research groups

15
TECNIO research centres

331
doctoral theses defended

2,425
articles in journals

1.011
new projects

14
registered patents

13
Technology-Based Companies

02

WATER, MARINE AND MARITIME RESOURCES

In the field of research, development and innovation (R&D), the terms **water resources**, **marine resources** and **maritime resources** refer to different aspects of the natural environment that are related to bodies of water.

WATER
RESOURCES

All water sources available to society. Sources of surface water (rivers, lakes and reservoirs) and groundwater (aquifers) and sources for human consumption, agriculture, industry and ecosystem maintenance.

R&D focuses on understanding the availability, quality, distribution and sustainable management of water, as well as on natural hazards, such as floods and landslides caused by intense rainfall, which have increased due to climate change. These factors are studied and technologies and strategies are developed to improve water supply, scarcity and pollution.

MARINE
RESOURCES

A broader category that includes all resources related to human activities and infrastructure in and around the seas and oceans.

This includes not just living and non-living marine resources (beaches, dunes, coastal lagoons, etc.) but also other elements such as maritime transport, coastal infrastructure, marine energy and exploration and extraction of oil, gas and minerals.

R&D implies a multidisciplinary focus on areas such as engineering, law, spatial planning and conservation.

MARITIME
RESOURCES

Living organisms and non-living components (minerals, energy sources and sediments) found in oceans, seas and other bodies of salt water.

R&D in marine resources involves studying biodiversity, ecosystems, fisheries, aquaculture and new biotechnological applications, as well as natural hazards. The aim is to sustainably conserve marine resources, taking into account issues such as overfishing and habitat degradation, and to develop innovative approaches to the responsible use of ocean resources.

THE EFFECT OF CLIMATE CHANGE

All resources interact

Rivers provide nutrients that maintain marine ecosystems and the sediments needed for coastlines, but they can also affect them negatively by bringing pollutants and triggering natural hazards.

WATER
RESOURCES

Climate change and natural hazards

Natural hazards are more frequent and intense due to climate change, and they can together trigger compound events that degrade the quality, quantity and availability of water, marine and maritime resources and slow and impoverish their natural regeneration.

MARINE
RESOURCES

MARITIME
RESOURCES

In short, water resources focus on the availability and management of fresh water, while marine resources focus on living and non-living resources found in saltwater environments.

Maritime resources, on the other hand, include a wider range of aspects, including marine resources, human activities and infrastructure related to coastal and ocean environments.

In research and innovation, challenges are addressed and sustainable solutions are developed for the use and conservation of water bodies and their resources.

STATE OF THE ART - WATER RESOURCES

Water quality monitoring and treatment

Advanced sensor technologies and data analysis have enabled real-time monitoring of water quality, helping to detect contaminants and ensure safer drinking water. In addition, research has focused on developing efficient and ecological water treatment methods.

Water conservation and management

Integrated water resource management techniques have been developed to optimise the use of water in agriculture, industry and urban areas. This includes water recycling, rainwater harvesting and demand-side management practices.

Desalination technologies

Desalination, the process of turning seawater into fresh water, has seen significant advances in membrane technologies and energy-efficient methods, making it more viable to address water scarcity in coastal regions.

Climate change and water

Research has emphasised the impact of climate change on water resources, including changes in precipitation patterns, melting glaciers and rising sea levels, which influence the availability and distribution of water.

Groundwater management

Sustainable management of groundwater resources has become crucial and applies advanced modelling techniques and policies aimed at preventing aquifer overexploitation and depletion.

Natural hazards

They influence the safety and development of society. They are important in territorial management and have an impact on resources, activities, ecosystems and the population.

STATE OF THE ART - MARINE RESOURCES

Marine biodiversity and conservation

Advances in DNA sequencing and remote sensing have improved our understanding of marine ecosystems and biodiversity. Conservation efforts focus on identifying vulnerable species and preserving critical habitats.

Sustainable fishing and aquaculture

Integrated approaches to fisheries management have been developed, incorporating ecosystem-based principles to prevent overfishing and restore fish stocks. Aquaculture techniques are also evolving to minimise their environmental impact.

Marine biotechnology

Researchers are exploring the potential of marine organisms for biotechnological applications, such as developing new medicines, biofuels and biomaterials.

Deep sea exploration

Technological advances have enabled deep sea exploration and the discovery of new species and habitats and potential mineral resources.

Mitigation of marine pollution

Research has focused on addressing marine pollution, including plastic waste, oil spills and nutrient runoff, through strategies that improve waste management and pollution prevention.

Marine risks

They mainly influence economic activity and tourism through coastal and beach resources. They include factors such as erosion, storm flooding and pollution.

STATE OF THE ART - MARITIME RESOURCES

Maritime transport and logistics

The aim of the research has been to optimise navigation routes, increase fuel efficiency and reduce greenhouse gas emissions in the maritime industry.

Marine energy

Advances in wind, wave and tidal energy technologies are being worked on intensely to harness the ocean's renewable energy.

Marine spatial planning

Developing effective marine spatial planning strategies helps balance multiple ocean uses, including conservation, fisheries, tourism and maritime development.

Deep sea mining

The research is exploring the environmental impact and technological challenges of extracting mineral resources from the deep seabed.

Maritime security and law

Efforts to improve maritime security involve the study of piracy, illegal fishing and effective legal frameworks to protect marine resources and ensure responsible use of the ocean.

03

RESEARCH AND INNOVATION

Through the research groups distributed across its schools, the UPC has facilities and resources to provide its own services in the areas of diagnosis, advice, development, demonstration, training, promotion and support to industry, the public sector and civil society in promoting and deploying water, marine and maritime resources.

KEYWORDS

General keywords
- Climate change
- Conservation

Water resources
- Fresh water
- Surface water
- Groundwater
- Desalination
- Water shortage
- Water stress
- Groundwater management
- Integrated management of water resources
- Rainwater
- Water quality
- Water recycling
- Drought
- Water treatment

- Pollution
- Erosion
- Flooding

Marine resources
- Aquaculture
- Coral reefs
- Marine biodiversity
- Marine biotechnology
- Marine conservation
- Marine pollution
- Marine ecosystems
- Deep sea exploration
- Coastal management
- Fisheries management and sustainable fishing
- Marine habitats
- Marine mammals
- Deep sea mining
- Oceanography

- Natural hazards
- Tourism

Maritime resources
- Maritime law
- Marine wave energy
- Marine tidal energy
- Marine energy: offshore wind
- Port management
- Naval industry
- Marine infrastructure
- Maritime logistics
- Deep sea mining
- Navigation
- Marine spatial planning
- Maritime security
- Maritime transport

Examples of activity I – Water resources

Development of innovative integrated separation technologies to recover minerals in the process of desalination of sea water.

Studies on the impact on quality of groundwater and the risk of pollutants.

Analysis of precipitation and management of danger and risks due to an excess or lack of rainfall.

Development of hydraulic behaviour analysis tools, for example, in the sewer network.

Management of risks associated with developing policies and strategies for mitigating the negative impact of hydrological challenges such as floods, droughts and dangerous debris avalanches.

Creation of digital twins to optimise the use of water resources available for irrigation, mitigating the effects of growing water scarcity in agriculture and improving food security.

Reuse of treated water from wastewater treatment plants to increase drinking water supply.

Examples of activity II – Marine resources

Numerical simulations to describe the global pathways of marine waste.

Regeneration of coral reefs through the breeding and repopulation in oceanariums of polyps and anthozoans, which then lodge in the calcareous structures that are intact.

Detection of marine life integrating genomic, bio-optical and participatory technologies.

Study of the distribution of microplastics and their interaction with marine flora and fauna.

Development of systems for locating and monitoring marine species to obtain patterns of activity and mobility for sustainable fisheries management.

Production of proteins for food from by-products of the agri-food sector by cultivating microalgae.

Artificial intelligence applied to estimating the size of fish species.

Examples of activity III – Maritime resources

Evaluation of the risk of ship collision in the waters of maritime routes.

Management of energy and emissions on board ships, to save energy, reduce pollution and improve the energy efficiency of maritime transport.

Study of climate emergency governance and regulations on coasts.

Study on the application of composite materials to offshore naval and energy structures to minimise their environmental impact.

Development, engineering, production and life cycle management of improved materials for the structure and functional components of large wind and tidal energy platforms.

Examination of the correlation between ship traffic in the vicinity of a port and air quality during ship approach, manoeuvring and berthing.

Improvement in coastal management capacity.

Improved understanding of the physics governing patterns of wave breaking and sediment transport.

UPC RESEARCH GROUPS IN WATER RESOURCES

- **CRAHI - Centre of Applied Research in Hydrometeorology**

- **FLUMEN - River Dynamics and Hydrological Engineering**

- **GHS - Hydrogeology Group**

- **Geo2Aqua - Monitoring, Modelling and Geomatics for Hydrogeomorphological Processes**

- **HorPTA - Horticulture: Production, Transformation and Use**

- **R2EM - Resource Recovery and Environmental Management**

- **SAC - Advanced Control Systems**

UPC RESEARCH GROUPS IN MARINE RESOURCES

- **BIOCOM-SC - Computational Biology and Complex Systems Group**

- **GEMMA - Environmental Engineering and Microbiology Group**

- **GReCEF - Fluid Science and Engineering Research Group**

- **LAB - Laboratory of Applied Bioacoustics**

- **SARTI - Technological Development Centre for Remote Acquisition and Data Processing Systems**

- **SARTI-MAR - Remote Data Acquisition Systems and Information Processing in the Marine Environment**

Research subgroups

- **SPAq - Aquaculture Production Systems**

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UPC RESEARCH GROUPS IN MARITIME RESOURCES

- **ATEM - Analysis and Technology of Structures and Materials**

- **BIT - Barcelona Innovative Transportation**

- **CDIF - Centre for Industrial Diagnostics and Fluid Dynamics**

- **CITES - Sustainability Science and Technology Research Group**

- **RIIS - Research Group on Intelligent and Sustainable Resources and Industries**

- **DF-GeoTech - Fluid Dynamics: Structure Formation and Geophysical Applications**

Research subgroups

- **EGEO - Geomatic Engineering**

- **IFLUIDS - Barcelona Fluids and Energy Lab Research Group**

- **TRANSMAR - Maritime Transport and Port Logistics Research Group**

OTHER UPC WATER RESEARCH GROUPS

- **CITCEA - Centre for Technological Innovation in Static Converters and Drives**

- **CREDA - Centre for Agrifood Economics and Development**

- **GIES - Geophysics and Earthquake Engineering**

- **GRU - Urbanism Research Group**

- **LRG - Lightning Research Group**

- **LUB - Barcelona Urbanism Laboratory**

- **PM - Programming Models**

UPC RESEARCH CENTRES IN WATER, MARINE AND MARITIME RESOURCES

LIM/UPC - Maritime Engineering Laboratory

The objectives of the LIM are research, knowledge transfer and the preparation of highly qualified professionals in the field of maritime engineering and marine sciences, from the main physical processes that occur in the coastal zone to those that occur in the continental shelf.

AGROTECH-UPC - Agri-Food Technology Specific Research Centre

The Agri-Food Technology Specific Research Centre brings together UPC research groups and research staff to carry out activities related to agri-food technology, both from the standpoint of agronomy and from a more technological or sustainability standpoint.

CREMIT – Centre for Engines and Heat Installations

The aim is to join two small, consolidated research groups, one of which specialises in heat engines and machines (CREMIT) and the other in cooling and heating equipment (CER). The common aims for the next three years are to produce knowledge for publication in scientific journals in the aforementioned fields and to transfer the results of research to companies and public institutions.

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UPC RESEARCH CENTRES IN WATER, MARINE AND MARITIME RESOURCES

IDEAI-UPC - Intelligent Data Science and Artificial Intelligence Research Center

SSR - Smart Sustainable Resources

CS2AC-UPC - Supervision, Safety and Automatic Control

IDEAI-UPC is a research centre made up of seven specialised research centres in the different branches of AI. It has a group that studies the water sector to apply artificial intelligence to wastewater treatment and water distribution networks. It also contributes its technology to research in the field of natural resources and the environment.

The CER-SSR consolidates its research activity in the field of the use of mineral resources and sustainable and intelligent mining and the use of urban, industrial and mineral waste.

The CS2AC focuses on the field of automatic control and system supervision. Researchers at CS2AC-UPC use mathematical models to design advanced control and supervision systems capable of predicting, detecting, and diagnosing failures in real-time, optimizing the performance of complex systems. In the water sector, their research focuses on the efficient management and supervision of water networks and leak detection.

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BlueNetCat – Maritime Network of Catalonia

The BlueNetCat network is the Government of Catalonia's instrument for transfer and innovation in the blue economy. A fundamental part of the maritime agenda is the BlueNetCat network, which incubates and accelerates scientific and technological projects to promote them and bring them closer to the market. With this aim, BlueNetCat energises international meeting forums, promotes entrepreneurship and valorisation programs among its membres and organises scientific and technological missions to relevant countries in order to become a one-stop shop for blue innovation in Catalonia.

The BlueNetCat network is made up of 67 research groups belonging to five universities (UB, UAB, UPC, UdG, URV) and two research entities (IRTA and CSIC, including three of its centres in Catalonia: ICM, CEAB and IDAEA). A total of 700 people make up the network, of which around 400 are permanent research staff; the rest includes technical and trainee staff.

67 grups de recerca

30 productes en cartera

7 reptes de la xarxa

700 membres implicats

BlueNetCat Xarxa Marítima DE CATALUNYA

CEAB exploring aquatic ecosystems

CSIC Consejo Superior de Investigaciones Científicas

idaea

ICM Institut de Ciències del Mar

IRTA Institut de Recerca i Tecnologia Agroalimentàries

UAB Universitat Autònoma de Barcelona

UNIVERSITAT DE BARCELONA

Universitat de Girona

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UNIVERSITAT ROVIRA i VIRGILI

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COLLABORATORS

Companies

Research centres/institutes and public entities

04 UPC PROJECTS OF EXCELLENCE

In this document, projects of excellence are considered to be those in which:

- The scientific process is rigorous and meets high quality standards.
- They are strategic seed projects.
- They engage with social challenges and have a great scientific and socioeconomic impact.
- They have an impact on the territory.
- They include entities participating in the quadruple helix, which makes the projects multidisciplinary.

UPC projects of excellence are funded by programmes such as the State Plan and Horizon Europe.

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COREWIND - Cost reduction and increased performance of floating wind technology

The COREWIND project aims to achieve significant cost reductions and improve the performance of floating wind technology by researching and optimising mooring and anchoring systems and dynamic cables. These improvements arising within the project will be validated through simulations and experimental tests both in the wave basin tanks and in the wind tunnel, taking as references two concepts of concrete (semisubmersible and spar) floats that support large wind turbines (15 MW), installed at water depths greater than 40 m and 90 m for the semisubmersible and spar concepts, respectively.

UPC research group involved: Department of Civil and Environmental Engineering

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UPC PROJECTS OF EXCELLENCE

GOBEYOND - GeO and weather multi-risk impact Based Early warning and response systems supporting rapid deploYment of first respONders in EU and beyonD

GOBEYOND is an innovation project that will develop and test multiple impact-based early warning systems (MR-IEWSs) platforms for geological hazards and weather/climate events that are adapted to support civil defence authorities and first responders so that they become aware of the situation and achieve rapid deployment in Europe and beyond.

GOBEYOND will identify the most innovative algorithms in the field of geological hazards and incorporate them into available algorithms based on weather/climate impact in a common IEWS.

UPC research group involved: CRAHI

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GRADIENT - Hydrogeological resources at risk: confronting the impacts linked to climate change with the increase in water demand

The GRADIENT project addresses the problem of water scarcity in Barcelona due to climate change and the need to restore the River Ter. It focuses on the reuse of treated water from wastewater treatment plants to increase the supply of drinking water.

Using mathematical tools and laboratory studies, it will assess the potential harmful impacts on groundwater quality and the risk of contaminants reaching human activities.

The project will also develop an integrated probabilistic risk framework and apply the findings in a strategic aquifer near Barcelona to address water scarcity.

UPC research group involved: GHS

[iMagine](#) - Imaging data and services for aquatic science

iMagine provides image datasets and high-performance analysis tools with artificial intelligence and best practice documents for scientific image analysis.

These services and materials enable better and more efficient processing and analysis of image data in marine and freshwater research, accelerating scientific understanding of processes and measurements relevant to healthy oceans, seas and coastal and inland waters.

It uses the European Open Science Cloud platform and provides a generic AI framework for the development of AI models applicable to various areas such as pollution mitigation, biodiversity and climate change. Thirteen research institutions (RIs) will share images and applications through the project.

UPC research group involved: SARTI, SARTI-MAR

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SATURN - Solutions @ Underwater Radiated Noise

The SATURN consortium works to identify:
a) the most harmful sounds for aquatic species and how they are produced and propagated,
b) the short- and long-term negative impacts of ship noise on three representative groups of aquatic species in rivers and the sea (invertebrates, fish and marine mammals), and
c) the best options for measuring and reducing the negative impacts of ship noise on current and future vessels.

SATURN will contribute to establishing terminology and methodology standards for joint work on underwater radiated noise. An effective community of researchers, competent authorities, maritime operators, shipping and offshore industries and NGOs will be established to ensure that outcomes are tailored to the needs of all stakeholders and maximise implementation.

UPC research group involved: LAB

SUSTDESALT - Sustainable recovery of value-added elements from seawater desalination brines using hybrid separation technologies

The SUSTDESALT project addresses the scarcity of raw materials and water through desalination, which recovers valuable elements from brines.

It seeks to develop separation and concentration technologies using alternative energies to promote the circular economy and tackle the challenges of water scarcity and climate change.

Collaboration with industry provides case studies for the recovery of added value and water resources.

UPC research group involved: R2EM

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UPC PROJECTS OF EXCELLENCE

TRACE - Tools for a better management of marine litter in coastal environments to accelerate the TRAnsition to a Circular plastic Economy

The TRACE project aims to develop a floating system for monitoring and forecasting marine debris in coastal regions that addresses two important social demands:
- a better understanding of marine debris transport processes in coastal regions and
- the creation of a practical tool to contribute to improving waste management at local and regional scales, to achieve sustainable goals and accelerate the transition towards a circular plastic economy.

The expected results of the project will provide a better understanding of the magnitude and the transport mechanisms of floating marine debris in a densely populated coastal city (Barcelona) located in the Mediterranean Sea. It will help to understand the influence of environmental variables such as waves, currents and turbulence and the proportion of marine debris that returns to shore compared to marine debris exported out to sea, and the variables that control this process.

UPC research group involved: LIM

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UPC PROJECTS OF EXCELLENCE

JERICO-S3 - Joint European Research Infrastructure of Coastal Observatories: Science, Service, Sustainability

The Joint European Research Infrastructure of Coastal Observatories is a system of systems that strengthens the European network of coastal observatories by providing powerful and structured European research infrastructure dedicated to observing and monitoring complex marine coastal areas.

The goals of the project are the following:

I.   provide services to deliver high quality environmental data;
II. access solutions and facilities as services for researchers and users;
III. create product prototypes for core marine services and users in the EU; and
IV. support excellence in marine coastal research to better respond to social and policy needs.

UPC research group involved: SARTI

AI4WATER - Digital Twins for irrigated agriculture

El projecte AI4WATER proposa optimitzar l'ús dels recursos hídrics disponibles, mitigar els efectes de la creixent escassetat d'aigua en agricultura i millorar la seguretat alimentària mitjançant la creació d'un bessó digital .

El bessó digital permetrà simular, planificar, analitzar i millorar el creixement dels cultius, maximitzant el rendiment i fent-lo més sostenible per a l'agricultura. En concret, modelitzará els fluxos d'aigua de la zona de reg utilitzant com a entrades l'aigua captada del medi ambient, l'aigua retornada al mateix i la informació sobre els seus diferents usos (humà, industrial i agrícola segons la informació obtinguda dels comptadors d'aigua).

També es tindran en compte altres variables que influeixen en el balanç hídric, com les atmosfèriques, l'evapotranspiració i la humitat superficial del sòl (provinents dels satèl·lits AQUA/MODIS de la NASA i SMOS de l'ESA) i les dades d'una xarxa IoT de sensors d'humitat del sòl in situ que se situaran a diferents profunditats (a 5, 10 i 100 cm).

UPC research group involved: CommSensLab-UPC

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Improvement and operational integration on hydraulic efficiency of the Tarragona Water Consortium distribution network.

The project is a collaboration between UPC and the Tarragona Water Consortium (CAT) to improve the efficiency and reliability of Tarragona's water transport network. Researchers from UPC's CS2AC group will implement an automatic data validation system and assess the hydraulic efficiency of the network over a three-year period, issuing annual reports. The CAT network supplies 85% of Tarragona's population, and this project aims to optimize its management, which is key to responsible water management in the region.

UPC research group involved: CS2AC

ARTICLES

Falahzadehabarghouee, A. [et al.]. *A new coastal crawler prototype to expand the ecological monitoring radius of OBSEA cabled observatory.* **Journal of Marine Science and Engineering, 18 April 2023, vol. 11, no. 4, article 857.** http://hdl.handle.net/2117/387132
The article highlights using videos and environmental data from marine observatories for ecological monitoring. A benthic crawler is incorporated into a coastal observatory (OBSEA) to extend the data collection area and obtain information that provides a truer representation of the ecosystem.

Gutierrez, D. [et al.]. *Chemicals of emerging concern in coastal aquifers: assessment along the land-ocean interface.* **Journal of Hazardous Materials, April 2023, vol. 448, article no. 130876.** http://hdl.handle.net/2117/383003
This study assessed the presence and distribution of chemicals of emerging concern in a Mediterranean coastal aquifer near Barcelona. PFASs and the drugs carbamazepine and topiramate were highlighted as good markers of anthropogenic pollution in groundwater and marine waters at highly polluted sites.

Lloret, J. [et al.]. *Floating offshore wind farms in Mediterranean marine protected areas: a cautionary tale.* **ICES Journal of Marine Science, August 2023, vol. 0, p. 1.14.** https://doi.org/10.1093/icesjms/fsad131
The aim of this paper is to critically review the initial development of offshore wind energy in and/or around Mediterranean Natura 2000 sites and other types of MPAs and to assess the impact of the expansion of offshore wind energy.

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ARTICLES

Romero-Martín, R, [et al.]. *Mapping cumulative compound hydrometeorological and marine-induced risks on the NW Mediterranean coast.* **Scientific Reports, 14, 3237.** https://doi.org/10.1038/s41598-024-53899-z
The article analyses risk in the coastal areas of the Mediterranean that result from the interaction of hydrometeorological and marine hazards. It adopts a multi-hazard approach to risk management, within an index-based framework that assesses integrated risk in time and space.

Sanchez, X. [et al.]. *Present and future flooding and erosion along the NW Spanish Mediterranean Coast.* **Frontiers in Marine Science, July 2023, vol. 10.** http://hdl.handle.net/2117/390484
The article analyses the risk to coasts of flooding and erosion. Climate change and sea level rise are key factors. On the Catalan coast, 55 beaches were evaluated using numerical simulations.

Trapiello, C., Puig, V., Cembrano, G. Reconfiguration of flow-based networks with back-up components using robust economic MPC. "Journal of Process Control", 2023, vol. 122.
https://doi.org/10.1016/j.jprocont.2022.12.011
Aquest article presenta una metodologia per seleccionar una configuració òptima d'actuadors en xarxes basades en flux amb components de reserva després d'una fallada, combinant una anàlisi fora de línia per a configuracions mínimes i una cerca en línia de la millor configuració per gestionar els transitoris posteriors a la fallada, demostrada mitjançant una xarxa de transport d'aigua.

DOCTORAL THESES

Gutiérrez-Torre, A (2022). *Distributed cloud-edge analytics and machine learning for transportation emissions estimation*

This doctoral thesis focuses on the use of IoT and smart cities to get real-time information on a city's pollution. It explores the use of fog computing to process data in edge nodes and assesses the feasibility of implementing machine learning to correct data and make predictions. It makes three contributions: a distributed approach to building road traffic models, machine learning techniques to correct ship emissions data and the generation of new variables to predict ship characteristics.

Carandell, M. (2022). *Contributions to the design of energy harvesting systems for use autonomous sensors in low power marine applications*

This doctoral thesis focuses on using Lagrangian drifters as autonomous floating platforms to acquire marine data. It investigates the use of energy sources such as solar panels and wave motion energy converters to improve drifters' autonomy. A powered oceanographic monitoring system is proposed that can transmit location data and measurements of wave parameters.

Marín, B. (2023). *Experimental velocity profile distribution characterization of mountain rivers*

This thesis deals with the formulations used in managing the risk of floods in mountain rivers and seeks to improve the understanding of the behaviour of this type of river in order to be able to predict its morphological functioning. It aims to address the existing gap in river hydraulics in mountain rivers by investigating whether, and how, the logarithmic law equation can be applied to describe the velocity profile distribution in high-slope rivers with porous beds.

Francescangeli, M. (2023). *Technologically-sustained ecological monitoring of a coastal fish community with a highly integrated biological and environmental data*

The main objectives of this doctoral thesis contribute to the methodology of data collection and analysis in relation to marine ecological monitoring through wired observatories using high definition video cameras, to obtain biological data from the classification of identified individuals, which result in a spatiotemporal count of the different species and their dimensions.

05 SCIENTIFIC INFRASTRUCTURE

The UPC has facilities, resources and services that its scientific community uses to carry out top-tier research in its fields of knowledge. With regard to water, maritime and marine resources, five areas stand out:

- Environment
- Water treatment
- Water pollution
- Protection of coasts and courses of rivers
- Marine sciences and engineering

RESEARCH INFRASTRUCTURE

Environment

ORS infrastructure: remote sensing station (profiles of water vapour in the atmosphere, validation of forecast models). Hydrogeology Laboratory software. Laboratory of Applied Bioacoustics (open tank for calibration and acoustic measurement).

Water treatment

The Mineral Processing Laboratory has equipment for water quality management (flotation bench, hydrocyclone bench). And the Water Cycle Systems Control Laboratory develops algorithms to detect leaks, for treatment plants, etc.

Water pollution

The Multiscale Center has the capacity to develop catalysts for eliminating water pollutants: focused ion beam, X-ray photoelectron spectroscopy, near-ambient pressure X-ray photoelectron spectroscopy.

Coastal protection and river resources

Metrology and Calibration Laboratory (micrometers and cylindrical outer and inner diameter patterns), FLUMEN laboratories with piping and pumping systems to feed the different installations with flows of up to 400 l/s and advanced simulation tools.

Marine sciences and engineering

NanoSatLab facilities, designed to carry out environmental qualification tests, OBSEA cabled underwater observatory at 20 m depth, Marine Engineering Laboratory with CIEM and CIEMito large and small scale wave channels.

06

EDUCATION

BACHELOR'S DEGREES

Bachelor's degree in Naval Systems and Technology Engineering

Barcelona School of Nautical Studies (FNB)

The bachelor's degree in Naval Systems and Technology Engineering provides the knowledge needed to practise as a specialist in ship propulsion and systems. The degree is oriented towards technological activity related to naval engineering in areas such as ships and vessels of all types; floating and fixed platforms and structures (floating docks, structures for exploiting and utilising marine resources, and marine structures for generating renewable energy); marine nurseries and fishing systems; and other maritime industries.

Bachelor's degree in Marine Sciences and Technology

Barcelona School of Civil Engineering (ETSECCPB) / Barcelona School of Agri-Food and Biosystems Engineering (EEABB) / Vilanova i la Geltrú School of Engineering (EPSEVG)

The bachelor's degree in Marine Science and Technology is designed to build the scientific and technical professional skills needed to carry out research and provide advice on environmental and climate topics and on the impact of economic and social activities on the marine environment and coasts.

Bachelor's degree in Nautical Engineering and Maritime Transport

Barcelona School of Nautical Studies (FNB)

The bachelor's degree in Nautical Engineering and Maritime Transport provides the necessary technical knowledge to guarantee the optimal management of navigation manoeuvres, safety and pollution prevention, special freight, radio-electronic systems and other specialised matters.

BACHELOR'S DEGREES

Bachelor's degree in Marine Technologies
Barcelona School of Nautical Studies (FNB)

The bachelor's degree in Marine Technologies provides a solid grounding in the operation, maintenance and management of power plants and ship systems and in the design, reengineering and construction of vessels. It also provides training in the operation of offshore platforms for oil and gas extraction, dredgers, underwater machinery and any other industrial activity carried out in the maritime and land-based sector.

Bachelor's degree in Biosystems Engineering
Barcelona School of Agri-Food and Biosystems Engineering (EEABB)

The bachelor's degree in Biosystems Engineering combines biology and multidisciplinary training in areas such as microbiology, biochemistry, molecular biology, bioinstrumentation, in vitro culture and bioreactor operation, as well as techniques for bioenergy and biomaterial production, environmental bioremediation and aquatic organism production.

More bachelor's degrees: https://www.upc.edu/en/bachelors

MASTER'S DEGREES

Master's degree in Oceanography and Marine Management
Barcelona School of Civil Engineering (ETSECCPB)

The principal aim of the master's degree in Oceanography and Marine Management is to offer advanced theoretical and practical education in oceanography and the management of the marine environment, with a clear interdisciplinary focus and two specialisations.


Master's degree in Naval Architecture and Ocean Engineering
Barcelona School of Nautical Studies (FNB)

The master's degree in Naval Architecture and Ocean Engineering qualifies graduates to practise the regulated profession of naval and ocean engineer. It gives the knowledge needed to design, build, maintain and inspect ships and vessels of all kinds, as well as platforms and devices for the use of ocean resources.

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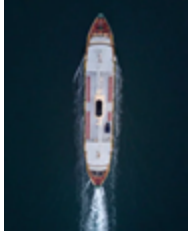
MASTER'S DEGREES

Master's degree in Nautical Science and Maritime Transport Management

Barcelona School of Nautical Studies (FNB)

The master's degree in Nautical Science and Maritime Transport Management provides high-level skills in the knowledge areas linked to nautical engineering and maritime transport: the structure and behaviour of ships at sea, maritime transport logistics and environmental management.

Master's degree in Management and Operation of Marine Energy Facilities

The master's degree in Management and Operation of Marine Energy Facilities gives students the knowledge and skills to design, plan, operate, maintain and manage marine facilities, covering the main safety, environmental and economic considerations in marine engineering from an interdisciplinary perspective.

More master's degrees: https://www.upc.edu/en/masters

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ERASMUS MUNDUS programmes

Erasmus Mundus master's degree in Coastal and Marine Engineering and Management (CoMEM)
Barcelona School of Civil Engineering (ETSECCPB)

The master's degree, coordinated by the Norwegian University of Science and Technology and with the UPC as a participant, is designed to provide advanced training to future scientists and engineers with responsibilities in coastal and port areas and offshore projects, including management and administration roles in sea-related engineering firms. During the programme, students familiarise themselves with key issues for providing sustainable, environmentally friendly, legally and economically acceptable solutions to problems in the fields covered by CoMEM.

Erasmus Mundus master's degree in Flood Risk Management
Barcelona School of Civil Engineering (ETSECCPB)

The master's degree, coordinated by the IHE Delft Institute for Water Education and with the UPC as a participant, provides an integrated approach to flood risk management that seeks to reduce human and socioeconomic losses caused by flooding.
The need to adopt an integrated, holistic approach to flood risk management is reflected in Directive 2007/60/CE (RD 903/2010, of 9 July, on flood risk assessment and management). To date, European programmes have dealt with a variety of technical aspects but failed to propose integrated management; in this respect, the Erasmus Mundus master's degree in Flood Risk Management constitutes a breakthrough in hydraulics training in Europe.

More master's degrees: https://www.upc.edu/en/masters

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DOCTORAL PROGRAMMES

Marine Sciences

The interuniversity doctoral degree in Marine Sciences, a joint initiative of the UPC, CISC research centres and the UB, trains high-level specialists in marine sciences and technologies.

Nautical and Marine Engineering and Naval Radio-Electronics

This programme aims to train top-level researchers in nautical and marine engineering and naval radio-electronics, providing them with the knowledge and skills needed to independently carry out research and innovation activities that enable the advancement and transfer of knowledge in this field.

Civil Engineering

The doctoral programme in Civil Engineering currently offered is an interdepartmental programme organised around six broad areas of knowledge that include water engineering, environmental engineering and sustainability.

More doctoral programmes: https://doctorat.upc.edu/en/programmes

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