Campus Internacional de Agua y Energía (CIAE)

- Energías Renovables en el Medio Marino
- Hidráulica Ambiental y Cambio Climático
- Ingeniería Marítima/Offshore
- Gestión de Riesgos del Ciclo Integral del Agua
- Gestión Integral de Cuencas y Zonas Costeras

- CSIC
- Santander
- Repsol
- Acciona
- Dragados
- APIAXXI
- SOGREAH
- IBERDROLA
- RenovaLia
- e-on
- Repower Systems A.G.
- KIER
- Halcrow
- ENGEES Strasbourg
- CANTABRIA GENERACIÓN, S.L.
- SENER
- IBERINSA
- Grupo Intercomercial de España
- Grupo prointec

- UIMP
- UC
- IH Cantabria
- Sódercan
- Plan de Energías Renovables
- NODO ALTAMIRA (ICTS)
- IDERMAR
- PCT Can Lab
- Vestas
- SIEMENS Competence Center
- CDTUC
- CTC
- CITAP

- Gobierno de Cantabria

- Universidad de Cantabria
IHCANTABRIA and Marine Renewables

• Assessment and forecast of energy resources in the marine environment (waves, wind, currents, tides)

• Design, development and testing of marine renewable energy technologies

• Environmental assessment of offshore and coastal marine renewable technologies

• Permitting of test, demonstration and production sites
Assessment and forecast of waves, wind and currents
LIFE CYCLE MANAGEMENT OF OFFSHORE ENERGY FARMS

1. PLANNING AND DESIGN/SITE SELECTION

2. CONSTRUCTION

3. OPERATIONS AND MAINTENANCE

4. RE-USE or DISPOSAL/REASSESSMENT
**PHASES OF THE LIFE CYCLE**

**Design phase:**
- long-term
- very-long term

**Construction phase:**
- short-term
- medium-term

**Operations and maintenance phase:**
- short-term
- medium-term

**Re-use/demolition/adaptation phase:**
- short, medium, long and very-long term

**Construction**

**Short-term**
- 24-72 hours Forecasting marine dynamics

**Medium term**
- Seasonal prediction (between 1 and 6 months)

**Long-term**
- Probabilistic analysis based on historical records

**Very-long-term**
- Long-term trends and projection to IPCC scenarios
IDERMAR has developed a new concept called **IDERMAR METEO** consisting of an **integral wind resource and ocean data acquisition system** based on a **floating structure**.

- For medium-depth and deep waters
- Easily adaptable to site-specific environmental conditions and monitoring system requirements established by the customer
- Easily transported and installed reducing economic costs and environmental impact
- Can be reused
- Certified product
Operational system for construction, operations and management
Integrated system for farm construction and operation

Wind & wave prediction (WAM model)

Propagation & agitation maps and the automatic design of the daily construction schedule.

Selection of the harbor geometry

Selection by the user the plain geometry and the different jobs and construction stage of the breakwater

Verification of the security thresholds by comparing the wave data at the toe of each structure

Run-up & overtopping catalog

Water levels
Integrated system for farm construction and operation
Integrated system for farm construction and operation

Marine renewable energies
Propagación S2O + MSP para la situación de avance del dique principal hasta el P.K. 2+700.

Día 21-01-2008 0:00 hrs
Integrated system for farm construction and operation
Design, development and testing of marine renewable energy technologies
Marine renewable energies

- Numerical modelling
- Physical modelling (wave basin and flumes)
- Test sites (wave energy, offshore wind energy)
Marine renewable energies

Own developments
Commercial models
Sesam (DNV)- Managing life cycle of offshore assets
Cantabria Coastal and Ocean Wave Basin
The experimental activity is focused on the field of marine engineering covering not only coastal but also deep water areas.
Goals

- Provide the international scientific community and the private companies with an integrated and hybrid experimental system which will allow us to considerably improve our knowledge of marine dynamics and their role in the technological challenges to be met by man in both shallow and deep water conditions.

- Contribute to generate research, development and innovation in the areas related with engineering and marine technologies.

- Serve as a magnet for initiatives, projects and human resources, allowing us to increase the competitive edge of Spain in the field and promote the economical development of Cantabria.

- Become a main development node for the marine renewable energies field in Cantabria.
Fields of work

- Marine Hydrodynamics
- Flow-structure interaction
- Coastal engineering
- Port engineering
- Maritime works and coastal protection structures
- Study of tsunamis and coastal risk
- Offshore technology
- Safety and reliability of marine structures
- Offshore platforms
- Marine renewable energy: Marine wind power, wave energy, currents
- Floating structures for different applications
- Marine geotechnics
- Materials engineering for marine environment
- Design of submarine vehicles
- Design of oceanographic instrumentation
- Analysis of constructive systems in marine environment
Technical description

Singularities

1. Experimental management system integration of the numerical and experimental modelling.
2. Water depth range for physical modelling (coast-offshore)
3. Different dimensions and scale integration
4. Dynamics integration (multidirectional waves, currents and wind)
5. Multi directional current generation capacity
6. Last generation numerical mirror
7. Synergies with other experimental facilities in Cantabria
   - High performance computation
   - Experimental offshore parks in Santoña and Ubiarco
   - Experimental floating meteorological mast to measure wind, waves and currents
   - Environmental parameters
Technical description

Experimental management system

Physical modelling system

Numerical modelling system

Hybrid experiments: both physical and numerical
Comparison of beach breaking waves
• These are experimental facilities which allow us to simulate waves, currents and wind and their interaction with coastal and offshore structures at different scales.

• The CCOB is a unique experimental wave basin and also has a shallow water basin and other specific wave flumes to be used for studies of tsunamis, wave simulation, currents and sediment transport at different scales.

• These facilities will be monitored with the most advanced measuring devices.
WAVE-CURRENT-WIND WAVE BASIN DIMENSIONS

**Length:** 30 m  
**Width:** 44 m  
**Minimum depth:** 0.2 m  
**Maximum depth:** 3.2 m  
**Pit:** 6 m diameter and 8 m deep, allows to simulate maximum water depth of 11 m.  
**Effective experimental area:** 640 m²
Technical description

**Wave generation:** Segmented system formed by 64 independent wave paddles (0.5m wide and 4.5m high). Each one is triggered by two articulated arms and a vertical connecting rod.

**Generation mode:** Piston and combined
Actuator systems: Hydraulic pistons, configured in 8 interconnected hydraulic groups which are commutable and with Nytrogen accumulators.

**Generated wave characteristics:**
Hmax = 1 m, T = 3 s (regular waves)
Hs = 0.6 m y Tp = 3 s (random waves) (h=3 m)
Tp = 0.5 s – 20 s for h= 0.2 a 3.2 m
Multidirectional waves (±45º).
Technical description

SECTION OF THE WAVE-CURRENT-WIND BASIN
Civil works: IH Compound
Location: Parque Científico y Tecnológico de Cantabria, Santander
Lot surface: 13,376,37 m²
Built surface: 16,523 m²
Technical description

Scaled model
Memorandum of Understanding
MICINN-Gov. of Cantabria
(19/12/2008)

Groundbreaking ceremony
(25/5/09)

Official opening (Marzo de 2011)
Synergies

Offshore wind marine dynamics measuring and floating tower
Test and demonstration sites in Cantabria

- Independent assessment of devices' energy conversion capabilities, structural performance and survivability
- Real-time monitoring and operational prediction of meteorological and marine resource conditions
- Evaluation of potential environmental impacts
- Assistance with grid connection and accreditations
- Extensive assistance with permitting & regulatory issues
- Extensive local research and engineering support
- Nearby access to sheltered water and harbours
- Complementary studies in the wave basin
Environmental assessment of offshore and coastal marine renewable technologies
• Assessment of the significance of changes to the inshore wave regime as a consequence of an offshore wind and wave farms

• Development of generic guidance for sediment transport monitoring programmes in response to construction of offshore wind and wave farms.

• Potential effects of electromagnetic fields (EMF) from offshore wind farm cables on fish

• Potential effects on marine birds

• Analysis of visual impacts of offshore wind farms

• Predicting the displacement of common species due to offshore wind and wave farms

• Assessment of sub-sea acoustic noise and vibration from offshore wind turbines and its impact on marine fauna

• Assessment and prediction of accidental spills during construction or operation: contingency plans
Environmental assessment of offshore and coastal marine renewable technologies

Changes to the inshore wave regime sediment transport and coastal morphodynamics
Formulation of the problem

- Reanalysis historical wave & wind data at deep water (44 year database)

- Offshore wind farm geometry, localization and structure characteristics (diameter, section, plain grid size, foundations, etc.)

- Measurements for calibration of the wave & wind database

- Wave & wind database clustering, and selection of N representative sea states.

- Numerical study of wave-structure interaction, for each particular wind farm geometry, in order to identify the transformation processes suffered by the waves.

- Numerical wave propagation of each cluster, with and without the presence of the wind farm structures.
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