The Coastal Management Modelling System - ES

1. Policy Objective & Theme

- ADAPTATION TO RISK: Managing impacts of climate change and safeguarding resilience of coasts/coastal systems
- ADAPTATION TO RISK: Preventing and managing natural hazards and technological (human-made) hazards
- ADAPTATION TO RISK: Integrating coherent strategies covering the risk-dimension (prevention to response) into planning and investment
- SUSTAINABLE USE OF RESOURCES: Preserving coastal environment (its functioning and integrity) to share space

2. Key Approaches

- Knowledge-based

3. Experiences that can be exchanged

In the event of a problem on the coast, this tool will enable us to define which studies must be conducted, the spatial and time scales to be applied, the numerical tools to be used and the input data required for our study. The effects of this problem on the coast can be precisely determined.

4. Overview of the case

The Coastal Management Modelling System (Sistema De Modelado Costero, SMC) is a computer tool that features a collection of numerical methods and models that enable us to study coastal processes and assess any changes in a beach due to natural events or human actions on the coast. The SMC is used to conduct studies on real coastal engineering projects, analysing actions throughout the different stages of a study: diagnosis, pre-design, design and environmental impact. These different stages cover the following analysis: bathymetric information, flood level determination, wave and dynamics characterisation, modal and morpho-dynamic states, terrain modelling and equilibrium beach, beach morpho-dynamic evolution and beach cross profile evolution.

5. Context and Objectives

a) Context

The SMC is part of the project "Coastal Modelling Aid System". This project was developed by the University of Cantabria for the Directorate General of Coasts of the Spanish Ministry of Environment. Both institutions agreed in 2002 to collaborate on the "Diffusion and distribution of numerical models for the technical assistance to the development of a model for coastal management". The aims of the Agreement are:

- To allow and facilitate an adequate distribution of the models to the different administrations, universities, and consulting groups related to the coast.
- To ensure that these institutions have sufficient information and knowledge of the developed tools. To this effect, courses will be held via Internet to instruct end-users on the usage of the model.

This tool has been designed to be implemented at the National, Regional or Local scale.

b) Objectives

The specific objectives to be achieved with the ICZM approach were: (1) to increase the knowledge on the dynamics and evolution of the coastal systems; (2) to design the necessary procedures to avoid beach recession and flooding in low coastal areas; (3) to establish a methodology in the design, execution and follow-up of the procedures carried out on the Spanish coast; (4) to develop a series of numerical tools that allows the application of the established methodologies; (5) compile the Spanish experience in the coastal engineering field.

The timescale associated with the implementation and goals achievement was 4 years (1996-2000)

6. Implementation of the ICZM Approach (i.e. management, tools, resources)

a) Project Management

This software was developed by the Environmental Hydraulics Institute IH Cantabria (formerly Ocean and Coastal Research Group from the University of Cantabria) and the Directorate General to the Coast in the Spain Ministry of Environment, within the Research Project "Coastal Modelling Aid System", funded by the Ministry of Environment.

b) ICZM tools

The SMC is a technical and planning tool, including the following modules:

- ODIN module which characterises the waves commonly needed by the user and can determine the mean directional wave regimes (wave height and period) at indefinite and target depths, the wave characteristics associated with the mean energy flow and the waves which characterise the annual, averaged conditions.
- BACO module which provides the end-user with bathymetric information available for the study zone. It provides image based and digitised, digital nautical charts (bathymetric data) and the possibility to generate an SMC project.
- ATLAS module which presents the visualisation of the results obtained in the thematic document on flood levels. It allows us to obtain the mean and extreme tidal and flood regimes for the Spanish coast.
- MOPLA module which allows the numerical simulation of wave propagations from indefinite depths towards the coast line. With this data, the induced current in the break zone can be obtained; therefore the morpho-dynamic evolution of a beach can be simulated.
- PETRA module which studies the short term cross-profile evolution. The model solves the sediment flow equations within the break zone as well as the bathymetric changes associated with the spatial variation in the sediment transportation. It aims to study the response of the beach plant form during a storm in regards to the coast line recession and the resulting beach profile.
- TIC module which compiles into one interactive document the most useful formulas and procedures used in coastal engineering. The programme is made up of a series of basic units for each particular issue. Each unit is separated into four subject groups: dynamics, sedimentary processes, marine works and environmental impacts.

7. Cost and resources

The budget for the design and implementation of this tool was €1,500,000. The manpower used for the implementation of the tool was approximately 45 people.

8. Effectiveness (i.e. were the foreseen goals/objectives of the work reached?)

The Spanish experience in the field of coastal engineering has been collected, analysed and used for the design of this tool which provides the necessary information to study and understand the coastal dynamics of a study zone as well as to design the specific measures to face and solve a specific coastal problem in the area. The objectives were achieved in the timescale defined.

9. Success and Fail factors

Factors that were helpful in achieving the objective were: (1) the political will of the person in charge at the competent administration (Director General for the Coast) to promote the training and capacity building of their technical staff in the Ministry of Environment; (2) the failure of several beach re-generation initiatives (carried out with the same methodologies that had previously succeeded) and the lack of understanding about why they had failed; (3) the budget availability; (4) free dissemination of the modelling tool.

A factor that hindered the achievement of the goals was the political changes in the first year of the project with the subsequent risks of budget cuts and/or failure.

10. Unforeseen outcomes

(1) The definition of a methodology to study the coastal processes based on short term and long term assessments; (2) the definition of the corresponding numerical methods and models which are nowadays the most used in Spain; (3) the creation of several databases for the tool, including waves and currents data, nautical charts etc.; (4) the use of the SMC in international cooperation projects, giving the software to coastal administration and training their technical staff. There is need for a continuous updating and upgrading.

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13. Sources

- http://www.ihcantabria.unican.es/en/software_SMC.asp
- González, M., Medina, R., González, J.M., Osorio, A.F., Méndez F.J., García, E. An integrated coastal modeling system for analyzing beach processes and beach restoration projects, SMC. Computer & Geosciencies (2007) 33 916 931 10.1016

SMC_Beach regeneration (3.29 MB)

SMC_Gonzalez et al. 2007 (2.64 MB)