Coastal zone GIS data model: a proposal for ICZM

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Abstract

In the past decades the Catalonian coastal area has been subject to an intense human pressure due to the high concentration of activities and settlements. Although some of the impacts are evident others are not and thus the assessment of the coastal zone's health is complicated. In order to address this issue we attempt to assess the state of the coastal ecosystem's ecological functions and services using a GIS. Due to the data driven characteristic of GIS a data model was defined based on specific management vision and goals. The proposed ad hoc data model includes the most common spatial features of the Catalonian coastal zone. Four main modules were defined as part of the core ICZM GIS: environmental, socio-economic, use and pressure/impact, and policy/management. Features on spatial layers were attributed with their behaviours as natural as they are supposed to be found on nature and/or anthropogenic environments. This special attributing provides to the database a more natural relationship among elements and environmental responses and constitutes its most relevant design issue. There is a growing need for a common spatial framework for coastal zone GIS for managerial purposes. Although GIS constitutes one of the most common analytical and synthetic tools in ICZM, a consensus on a general spatial data model still need to be achieved. It will also be desirable the incorporation of previous work on specific-area data model, especially in biodiversity and the marine environment.

The data model

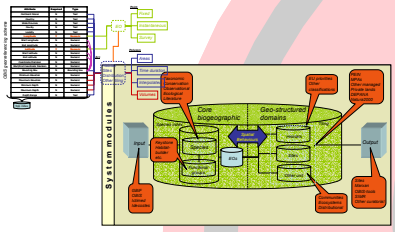
What is a GIS data model?

•A data model provides a basic template for implementing GIS projects (i.e., inputting, formatting, geoprocessing, and sharing data, creating maps, performing analyses, etc.)
•For developers, it provides a general framework for writing program code and maintaining applications
•To users/managers represents the scientific structure for data query, model, visualization and discovery

Do we need a specific coastal GIS data model?

YES,
•Understanding of the resource use patterns and its relation to the ecosystem health in the coast needs a robust spatial data model,
•A useful information system require data breath, depth and quality standards, and
•Coastal area sustainable development requires a more holistic ecosystem-based management approach supported by GIS

Environmental module: biodiversity example



Progress status:

•Module logical design
•Biodiversity prototype development
•Geodatabase implementation for Catalonian coast
•Consensus building among a bigger coastal management community

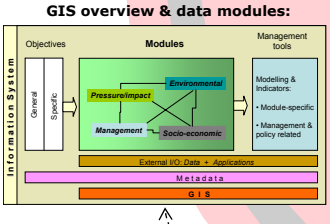
Previous developments:

•ESRI has put effort on data model development, ranging from base map to industry-specific areas
•ESRI's data models normally provide template and case study materials, see: http://support.esri.com/index.cfm?fa=downloads.dataModels.matrix
•Of major interest to coastal area are the Marine Data Model developed by ESRI, DUKE Univ. & OSU and the Nature-GIS data model (EU) (http://www.naturegis.net/)

Feature	Fixed points	Instantaneous points	Survey points	Boundary lines	Areas	Time duration areas	Regularly interpolated surfaces	Irregularly interpolated surfaces	Volumes
Attributes	ID X,Y Z	ID X,Y ΔZ t	ID X,Y ΔZ t1…t2	ID X1,Y1;X2, Y2… Z	ID X1,Y1;X2, Y2…X1,Y 1 Z	ID X1,Y1;X2, Y2…X1,Y 1 Z t1…tn	row1,col1 …row_col1 + Z1…Zn	row1,col1 …row_col1 + Z1…Zn	ID X1,Y1,Z1; X2,Y2,Z2 …X1,Y1,Z 1 Z t1…tn
Examples	Occurrence, conservation status	Biodiversity observation, fish densities, CTD, XBT	Samples, transects	Shoreline, EEZ, not enclosing area, legal boundaries, pressures, impacts	Habitats, distributions, pictures, MPAs, pressure, impact, ecoregion, community	Oil spill, presence / absence, range	Predicted distribution, bathymetry, SST, climatology, GeoTIF	Tiles, bathymetry	Front, plume, 3D habitat

Modified from Halpin, 2002

GIS overview & data modules:



Development plan:

Design	• Conceptual • Logical	• Spatial features • Biogeographical module
Implementation	• Prototype • Pilot Project (s) • Production	• GIS • Fish data base • Functional model • Impact model • Indicators

Our coastal management goals:

Contribute to:
•Water, Habitat, Bird, etc. EU Directive implementation
•Local ICZM Plan design in progress
•Mitigate human competition for coastal resources
•Address environmental state & human foot print on the coast
•*Provide a general GIS tool to coastal managers!*

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Nice, France, November 21st-26th 2005
University of Nice Sophia Antipolis – Valrose Campus

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