COINS – AN OPERATIONAL INDICATOR SYSTEM FOR INTEGRATED COASTAL ZONE MANAGEMENT

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The coastal areas have been under severe pressure during the last decades. The growing population in the coastal zone and the associated conversion of nature and agriculture land into built-up areas have enhanced the pressure on the coastal zones around the world. The consequences of this development was addressed and recognised at the World Summit in Rio de Janeiro in 1992, where the concept of Integrated Coastal Zone Management (ICZM) was given particular attendance in Agenda 21. The on-going global warming will enhance the pressure – primary due to sea level rise. The European answer to these challenges was two policy documents from the European Commission (2000; 2002) on Integrated Coastal Zone Management. Generally information technology is not considered as being an integrated part of the ICZM process, although technology plays a major role in the practical implementation of the policies and plans decided concerning for example dyke building. GIS played a role in most of the ICZM demonstration projects - mainly in the problem recognition phase and the planning phase (Capobianco, 2003).

However the role of GIS was mainly to produce maps meeting sectoral needs, whereas the full potential offered by a full integration and exchange of information using GIS was not exploited. Nevertheless, the awareness of the importance of informed decision-making is increasing. The EU ICZM Expert Group established a Working Group on Indicators and Data in 2002 to advise it on ways in which Member States, and the European Union as a whole, can assess whether they are moving further towards, or away from, a more sustainable future for their coastal zones. Several indicators have been suggested for monitoring the state of the coast, but the following criteria were used in the selection process: user driven, easy to understand and policy-relevant and scientifically sound. The indicators will allow benchmarking between countries and between regions, and facilitate the evaluation of the effect that their coastal strategies are having on coastal sustainability. The working group agreed on a list of 27 indicators composed of 46 measurements to monitor sustainable development in the coastal zone. The BLAST project on 'Bringing Land And Sea Together' (www.blast-project.eu) has participants from all countries around the North Sea and aims at improving Integrated Coastal Zone Management and Planning as by harmonising terrestrial and sea geographical data and by developing planning and visualisation tools in the context of climate change. The BLAST project is co-financed by the INTERREG IVB North Sea Region Programme.

To support the decision-making process in ICZM we have developed a Coastal Indicator System (COINS) by using the subset sustainability indicators mentioned above, but concentrating on the indicators particularly connected to the impact of climate change. A subset of the indicators is directly or indirectly related to climate change challenge and accordingly relevant for the work carried out in the BLAST project. This subset can be divided into three different groups: A) Control the development of earlier developed coast, B) Protect and enhance natural and cultural diversity, and C) Recognise the threat to coastal zones posed by climate change. The conceptual framework for COINS takes outset in the DPSIR framework developed by the European Environment Agency (2003). Referring to DPSIR framework group A refers to Drivers and Pressures, group B to States, and group C to Impacts.

The indicators implemented in COINS are: 'Demand for property on the coast', 'Area of built-up land', 'Rate of development of undeveloped land', 'Sea level rise and flooding hazard', 'Coastal erosion', 'Natural, human and economic assets at risk', and 'The coastal zone as a resource for renewable energy'.

The data behind the indicator calculations are harmonised land-sea data provided by the BLAST project aiming at more accurate and reliable indicator estimations. All data and indicators have associated metadata in accordance with the European INSPIRE specifications (European Communities, 2007).

Figure 1 and 2 illustrated the functionality of COINS by two indicator examples – both from Northern Jutland. The first example – figure 1 – shows the 'Area of built-up land' expressed as the percentage of built-up land by distance from the coastline. The indicator is estimated for two distance bands – a 1km wide zone representing the coast near areas and a 10km wide zone representing the hinterland. The indicator facilitates the assessment of the urbanisation pressure in the coastal zone compared with the coastal hinterland. The colours range from dark green (low built-up pct.) to orange (high built-up pct.). The narrow orange zone along the North-western coast around Hirtshals shows high built-up ratio in the near coastal zone compared to the hinterland. This is mainly due to high density of summer cottages and other leisure facilities. The second example – figure 2 – illustrates the flooding hazard due to a combined effect of 1 metre sea level rise and 1.6 metre storm surge corresponding to a 100 years event. This is clearly a disaster for Aalborg city – the main city in Northern Jutland with about 200,000 inhabitants for the city including suburbs.

COINS is a web-based application running directly in the browser of the user's computer. The underlying architecture is based on open source components and can therefore be used free of charge. The system is based on the INSPIRE principles European Community, 2007) both in terms of architecture and data. The core components of the system are PostGIS (Obe and Hsu, 2011) and Geoserver, creating INSPIRE compliant geographical services for the application. Background data for the application is provided as services by the appropriated data providers in each country, so that data maintenance and updating is conducted as close to the source as possible, to comply with the data provision instructions from INSPIRE. The application specific indicator data are results of advance geographical analysis, and the results are provided to the application as WMS services hosted by the COINS system.

The user interface is based on OpenLayers (Hazzard, 2011) and GeoEXT providing the user with a desktop GIS experience directly in the browser. Besides the most common map navigation functions, the COINS system is capable of letting the user interact with the system and the data in the application. For each of the indicators, a tool group has been created, enabling the users to visualise the implication of the selected indicators directly in the system, without having any prior GIS knowledge or skills. The indicator data can, free of charge for all users, be downloaded in many common GIS formats, enabling advanced users to download the indicator data and work further with them in the context they wish to apply it to. Finally, the COINS system enables the users to add their own data directly to the web application. This is accomplished by adding user determined WMS services to the application, making the COINS system a very flexible and adaptive system.
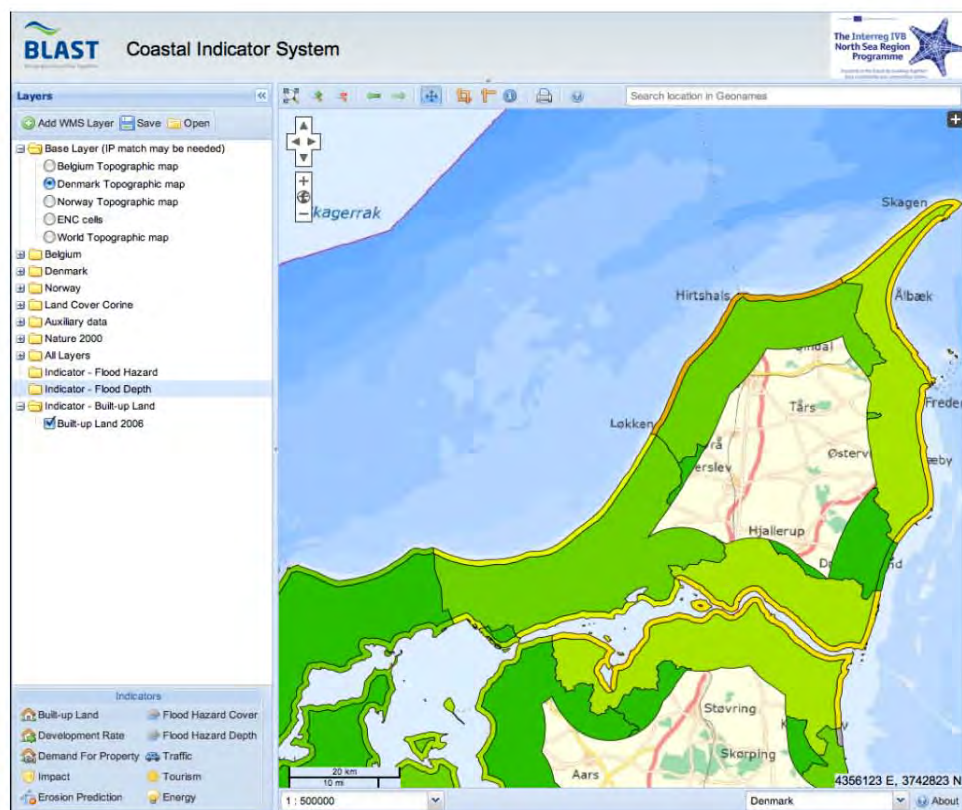
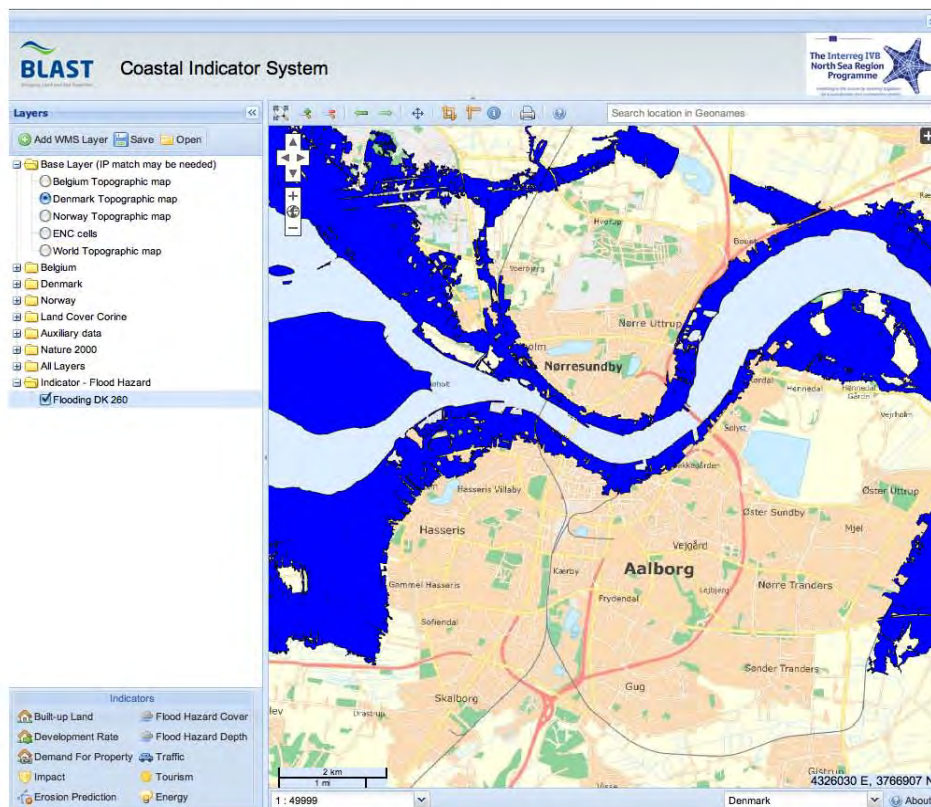Figure 1. Percentage of built-up land by distance from the coastline.

Figure 2. Flooding hazard (shown in blue colour) around the city of Aalborg.

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