Concepts and Science for Coastal Erosion Management

CONSCIENCE

Specific Targeted Research Project

Thematic priority: Forecasting and developing innovative policies for sustainability in the medium and long term

Assessment of European coastal erosion policies in relation to ICZM

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Contents

1 Introduction

The current report elaborates how CONSCIENCE is embedded in the framework of sustainable development and ICZM and how CONSCIENCE will support the further implementation of the EUROSION concepts.

Chapter 2 gives an overview of the EU principles/concepts related to ICZM: the sustainable development principles, the ICZM principles and the EUROSION management concepts. For each principle/concept the implementation progress and products are briefly described and most relevant conclusions and recommendations on further implementation actions are summarized. This chapter is wrapped up by the overview table 1 in paragraph 2.4.

Chapter 3 introduces the CONSCIENCE Frame of Reference for the further implementation and development of the EUROSION concepts. Based on the findings in Chapter 2, a summarized overview is given of all actions needed referring to the Frame of Reference (table 2). The chapter ends with the conclusions and recommendations.

2 EU principles/concepts related to ICZM

2.1 Sustainable development principles

2.1.1 Aim (what)

Sustainable development aims at the continuous improvement of the quality of life and well-being on Earth for present and future generations. To that end it promotes a dynamic economy with full employment and a high level of education, health protection, social and territorial cohesion and environmental protection in a peaceful and secure world, respecting cultural diversity [1].

2.1.2 Approach (how)

To serve as a basis for a renewed Strategy on Sustainable Development, the European Council in June 2005 approved a declaration with the following objectives and principles [1]:

KEY OBJECTIVES

ENVIRONMENTAL PROTECTION
Safeguard the earth's capacity to support life in all its diversity, respect the limits of the planet's natural resources and ensure a high level of protection and improvement of the quality of the environment. Prevent and reduce environmental pollution and promote sustainable consumption and production to break the link between economic growth and environmental degradation.

SOCIAL EQUITY AND COHESION
Promote a democratic, socially inclusive, cohesive, healthy, safe and just society with respect for fundamental rights and cultural diversity that creates equal opportunities and combats discrimination in all its forms.

ECONOMIC PROSPERITY
Promote a prosperous, innovative, knowledge-rich, competitive and eco-efficient economy which provides high living standards and full and high-quality employment throughout the European Union.

MEETING OUR INTERNATIONAL RESPONSIBILITIES
Encourage the establishment and defend the stability of democratic institutions across the world, based on peace, security and freedom. Actively promote sustainable development worldwide and ensure that the European Union’s internal and external policies are consistent with global sustainable development and its international commitments.

POLICY GUIDING PRINCIPLES

PROMOTION AND PROTECTION OF FUNDAMENTAL RIGHTS
Place human beings at the centre of the European Union's policies, by promoting fundamental rights, by combating all forms of discrimination and contributing to the reduction of poverty and the elimination of social exclusion worldwide.

SOLIDARITY WITHIN AND BETWEEN GENERATIONS
Address the needs of current generations without compromising the ability of future generations to meet their needs in the European Union and elsewhere.

OPEN AND DEMOCRATIC SOCIETY
Guarantee citizens' rights of access to information and ensure access to justice. Develop adequate consultation and participatory channels for all interested parties and associations.

INVOLVEMENT OF CITIZENS
Enhance the participation of citizens in decision-making. Promote education and public awareness of sustainable development. Inform citizens about their impact on the environment and their options for making more sustainable choices.

INVOLVEMENT OF BUSINESSES AND SOCIAL PARTNERS
Enhance the social dialogue, corporate social responsibility and private-public partnerships to foster cooperation and common responsibilities to achieve sustainable consumption and production.

POLICY COHERENCE AND GOVERNANCE
Promote coherence between all European Union policies and coherence between local, regional, national and global actions in order to enhance their contribution to sustainable development.

POLICY INTEGRATION
Promote integration of economic, social and environmental considerations so that they are coherent and mutually reinforce each other by making full use of instruments for better regulation, such as balanced impact assessment and stakeholder consultations.

USE BEST AVAILABLE KNOWLEDGE
Ensure that policies are developed, assessed and implemented on the basis of the best available knowledge and that they are economically sound and cost-effective.

PRECAUTIONARY PRINCIPLE
Where there is scientific uncertainty, implement evaluation procedures and take appropriate preventive action in order to avoid damage to human health or to the environment.

MAKE POLLUTERS PAY
Ensure that prices reflect the real costs to society of consumption and production activities and that polluters pay for the damage they cause to human health and the environment.

2.1.3 Implementation progress

- 1st EU SDS adopted in 2001
- Renewed SDS adopted in 2006
- 1st progress report on SDS in 2007

The European Council in Göteborg (2001) adopted the first EU Sustainable Development Strategy (SDS). This was complemented by an external dimension in 2002 by the European Council in Barcelona in view of the World Summit on Sustainable Development in Johannesburg (2002).

In 2005 the European Council set out principles to guide Europe on a sustainable path of development. These principles include the ongoing need to foster economic prosperity based on an innovative, competitive and eco-efficient economy, protecting and improving the quality of the environment; promoting equity and social cohesion in solidarity with the rest of the world.

In 2006 the European Council adopted a renewed Sustainable Development Strategy (SDS) that sets out a single, coherent plan on how the EU will more effectively live up to these principles and the overarching objective of sustainable development enshrined in the Treaty. The plan consists of 7 key challenges which must be tackled if Europe is to move along a sustainable development path and maintain current levels of prosperity and welfare (Climate Change and clean energy, Sustainable Transport, Sustainable consumption and production, Conservation and management of natural resources, Public Health, Social inclusion, demography and migration, Global poverty and sustainable development challenges). It recognised that SDS goals can only be met in close partnership with the Member States and hence set in motion a new process of review and reporting involving the Commission and the Member States.

In 2007 a progress report was due. This Progress report is the first stocktaking based on this new way of working. It reviews results in moving towards the seven core objectives and identifies policy initiatives at both EU and MS level that have contributed to these results. Because it would not have been possible to show meaningful trends on the basis of one year's data, 2000 is taken as a baseline against which progress is measured in the different areas.

Actions in the framework of key challenge 'Climate Change and clean energy' includes the implementation of the European Climate Change Programme (ECCP) regarding climate change mitigation and adaption.

2.1.4 Conclusions and recommendations regarding further implementation of coastal management issues

In key challenge 'Conservation and management of natural resources' is mentioned [1]:

- The Commission and Member States should work towards improving integrated water resources management, the marine environment and promoting integrated coastal zone management.
- On the basis of the Commission Green Paper on maritime affairs, ocean and sea related policies will be developed in a more sustainable and integrated fashion from 2008 onwards.

In ECCP II, which is part of key challenge 'Climate change and clean energy', is mentioned that regarding flood risk and coastal erosion management, work on climate change in the coastal zone could be integrated with an understanding of the overall

coastal policies in operation. There may be a place for funding structures in relation to flooding and coastal erosion or related plans [2].

Almost all Member States have now adopted national climate change strategies, either as a separate strategy or as a part of national energy policy packages. Some have set up specific offices and scientific councils to deal with climate change (UK,SE). Continued efforts need to be made to meet climate change and energy targets within the agreed deadlines. This will require continued attention to making a success of the Emissions Trading scheme; promoting renewables and sustainable use of biofuels and developing climate change adaptation strategies and plans [3].

The progress report shows that progress on the ground is modest but that policy development at both EU and Member State level has progressed significantly in many areas, notably on climate change and clean energy. The priorities set in the June 2006 strategy remain valid. Continued attention needs to be paid to implementation in all priority areas [3]. There are no specific remarks about coastal (erosion) management.

2.2 ICZM principles

2.2.1 Aim (what)

The EU ICZM Recommendation calls for a strategic approach to coastal zone planning and management in order to achieve sustainable development. Policies and legislation on coastal management and their implementing mechanisms have, by and large, been developed separately from each other and on a purely sectoral basis. This can lead to conflicting priorities, a lack of clarity and overall a fragmented approach when it comes to implementing the relevant policies and legislation. A more coherent and integrated approach to coastal planning and management should provide a better context to benefit from synergies, to level out inconsistencies, and ultimately to better and more effectively achieve sustainable development. This is what integrated coastal zone management is about and is the aim of the EU ICZM Recommendation [4, 5, 8].

2.2.2 Approach (how)

The EU ICZM Recommendation lists eight principles defining the essential characteristics of ICZM[1]. Integration across sectors and levels of governance, as well as a participatory and knowledge-based approach, are hallmarks of ICZM. Based on these principles, the EU ICZM Recommendation invites coastal Member States to develop national strategies to implement ICZM. Given the cross-border nature of many coastal processes, coordination and cooperation with neighbouring countries and in a regional sea context are also needed [4, 5, 8].

To support the implementation of the ICZM Recommendation, an EU working group on indicators and data was formed to establish 2 set of indicators, one aimed to measure progress in ICZM (process indicators), the other one measuring sustainability on the coast (sustainability indicators) (see Appendix 1) [6].

1. The 8 principles are not specific to the coast, but rather are fundamental components of good governance. Therefore in no way is suggested that the same principles should not be applied to the rest of the EU territory. The principles behind this ICZM Strategy closely parallel those of the European Spatial Development Perspective (ESDP), and are also mirrored in the Commission's urban activities (EU COM/2000/547, 2000)

ICZM Principles

In formulating national strategies and measures based on these strategies, Member States should follow the principles of integrated coastal zone management to ensure good coastal zone management, taking into account the good practices identified, inter alia, in the Commission's demonstration programme on integrated coastal zone management. In particular, coastal zone management should be based on:

(a) a broad overall perspective (thematic and geographic) which will take into account the interdependence and disparity of natural systems and human activities with an impact on coastal areas;

(b) a long-term perspective which will take into account the precautionary principle and the needs of present and future generations;

(c) adaptive management during a gradual process which will facilitate adjustment as problems and knowledge develop. This implies the need for a sound scientific basis concerning the evolution of the coastal zone;

(d) local specificity and the great diversity of European coastal zones, which will make it possible to respond to their practical needs with specific solutions and flexible measures;

(e) working with natural processes and respecting the carrying capacity of ecosystems, which will make human activities more environmentally friendly, socially responsible and economically sound in the long run;

(f) involving all the parties concerned (economic and social partners, the organisations representing coastal zone residents, non-governmental organisations and the business sector) in the management process, for example by means of agreements and based on shared responsibility;

(g) support and involvement of relevant administrative bodies at national, regional and local level between which appropriate links should be established or maintained with the aim of improved coordination of the various existing policies. Partnership with and between regional and local authorities should apply when appropriate;

(h) use of a combination of instruments designed to facilitate coherence between sectoral policy objectives and coherence between planning and management.

2.2.3 Implementation progress (process)

- ICZM Demonstration program (1996 - 1999)
- Adoption of ICZM recommendations (2002)
- EU-ICZM expert group / working group on indicators (since 2002)
- EUROSION project (2002 - 2005)
- SAFECOAST (2005 -2008)
- EEA produced a 'State-of-the-coast assessment' (2006)
- Evaluation of the implementation of ICZM recommendations, 2006
- Report on the use of the ICZM indicators, 2006
- EC review of ICZM implementation and policy directions for the future, 2007
- Protocol on ICZM in the Mediterranean signed on Januari 2008
- EC contract to support the implementation of ICZM (Dec, 2008)
- Many EU Projects on coastal and flood (risk) management (2000 – 2008)

Many of Europe's coastal zones face problems of deterioration of their environmental, socio-economic and cultural resources. Since 1996, the European Commission has been working to identify and promote measures to remedy this deterioration and to improve the overall situation in our coastal zones.

From 1996 to 1999, the Commission operated a **Demonstration Programme** on Integrated Coastal Zone Management (ICZM) designed around a series of 35 demonstration projects and 6 thematic studies. This programme was aimed to:

- Provide technical information about sustainable coastal zone management, and
- Stimulate a broad debate among the various actors involved in the planning, management or use of European coastal zones.

The programme was intended to lead to a consensus regarding the measures necessary in order to stimulate ICZM in Europe.

In 2000, based on the experiences and outputs of the Demonstration Programme, the Commission adopted two documents for the implementation of ICZM in Europe: an **ICZM Strategy [4] and ICZM recommendations**[2] **[5]**. The Communication explains how the Commission will be working to promote ICZM through the use of Community instruments and programmes. The Recommendation outlines steps which the Member States should take to develop national strategies for ICZM.

To support the implementation of the ICZM Recommendation, the Commission facilitates an **expert group**, which held its first meeting on 3 October 2002. A **working group on indicators and data** was formed to establish 2 set of indicators, one aimed to measure progress in ICZM, the other one measuring sustainability on the coast [6].

As a follow-up to the EU demonstration program on ICZM the overall aim of the **EUROSION** project was to provide quantified evidence on coastal erosion in Europe, on the problems caused by it and on the successes and failures of mitigation measures, based on 60 pilot sites. Moreover recommendations for policy-making and information management practices to address coastal erosion in Europe were formulated to bring coastal erosion into the mainstream of coastal management at the European, national, regional and local levels [12].

In 2005 the **SAFECOAST** project set out to answer the question: 'How to manage our North Sea coasts in 2050?' and focused on scenarios of future change and risk management with respect to coastal flooding and erosion[3]. Earlier findings of project Comrisk were taken further into the context of future risks and challenges to inform science, management and policy [11].

To inform the evaluation of ICZM in Europe, the EEA produced a '**State-of-the-coast assessment**' [10]. This report provides information on the state of the environment in the coastal areas of Europe, and provides evidence of the need for a more integrated, long-term approach.

Evaluation of the implementation of ICZM recommendations

2. Adopted by Council and Parliament on 30 May 2002.

3. The EU Floods Directive (2007) requires Member States to assess the watersheds and coastal areas that are at risk from flooding (by 2011); to map the flood extent and assets and humans at risk in these areas (by 2013); and to take adequate and coordinated measures to reduce this flood risk (by 2015). The outcomes of project Safecoast may serve as a (coastal flood risk) reference framework for the implementation of the directive (Safecoast, 2008).

The EU ICZM Recommendation (Chapter VI.3) requested the EC to present an evaluation report to the Council and the European Parliament. The external assessment was done in 2006. The objectives of the evaluation were [7]:

- To evaluate the implementation of the EU ICZM Recommendation of May 2002
- To evaluate the added-value of ICZM in the context of relevant existing and evolving Community policies/legislation
- To identify where a need for further action exists as regards coastal zone policy and to provide recommendations for further relevant action at Community level.

During 2006 and the beginning of 2007 the **Commission reviewed** the experience with the implementation of the EU ICZM Recommendation. The review report presents the conclusions of this evaluation exercise and sets out the main policy directions for further promotion on ICZM in Europe [8].

EU is a Contracting Party to the UNEP Mediterranean Action Program for the Barcelona Convention. During the last six years in the framework of this convention an **Protocol on ICZM** is being developed and signed in January 2008. The protocol is still to be ratified and implemented. It will allow the Mediterranean countries to better manage and protect their coastal zones, as well as to deal with the emerging coastal environmental challenges, such as the climate change. This Protocol is considered a unique legal instrument on ICZM and could serve as model for other regional seas [9].

In June 2008, the **EC launched a 1 M€ contract** to support the exchange of experiences and best practices in coastal management. This will incorporate formulation of recommendations to support the implementation and a possible review of the EU ICZM Recommendation and/or to underpin the further development of the EU Maritime Policy. In Dec 2008 this contract is commissioned to a consultancy company in the Netherlands (Arcadis).

Many EU Projects on coastal flood and risk management in the last decade

Since 1995, concern about the state of Europe's coastline has led to a number of EU initiatives, which build on the concept of ICZM, exchanging knowledge and showing best practices. In table A below, a (non exhaustive) list is given of coastal and flood management related projects that are funded by the EU [11].

D EU research FP5-6	Focus	Interreg North Sea Programme	Focus	Interreg North West Programme	Focus
Coastview	Coastal monitoring	Chain of Safety	Transnational crisis management	BAR [c]	Coastal erosion
Conscience	Coastal erosion & sediment behaviour	Comcoast	Coastal management concept	Branch	Land use and climate change
Dinas-coast	Coastal vulnerability	Comrisk	Coastal flood risk management	Copranet	Practitioners network
Encora	Coordinated knowledge network	Flows	Flood plain land use	Corepoint	ICZM
Eranet-Crue	Science & policy integration	Frame	Flood risk in estuaries	Espace	Space for water
Erograss	Flood defence stability	Lancewadplan	Wadden sea cultural heritage	Flapp	Flood awareness and prevention
EuroGoos	Marine monitoring	Norvision	Spatial planning	Floodscape	Space for water
Eurosion [a]	Coastal erosion management in EU	Response [b]	Coastal erosion and climate change	Messina	Monitoring and valuation
Floodsite	Flood risk science and management	Safecoast	Future coastal risk management	Nofdp	Nature and flood prevention
Motiive	Data harmonisation			Sail	ICZM
Newater	Adaptive water management			Scaldit	Scheldt estuary integrated vision
Spicosa	Science & policy integration				
a) Service contract with EC / DG Env. b) EU Life programme. c) Interreg 3a project					

Table A An alphabetically ordered selection of recently EU funded (coastal or river) flood and erosion risk management related projects [11]

2.2.4 Conclusions and recommendations regarding further implementation

Evaluation of the implementation of ICZM recommendations [7]

The evaluation report mentions the following recommendations (see Appendix 2 for the full text including proposed actions):

1. Strengthen the European dimension of ICZM based on a Regional Seas approach
2. Raise the profile of ICZM and enhance its integration with sectoral policies
3. Elaborate the strategic approach of ICZM - oriented at a balanced ecologic, social, economic and cultural development
4. Address major long-term risks: Vulnerability to disasters and climate change
5. Endorse awareness, guidance, training and education
6. Enhance stakeholder coordination and participation
7. Perform a mainstreaming of European policies
8. Harmonise monitoring and evaluation frameworks
9. Improve the knowledge basis for ICZM

EC review of ICZM implementation and policy directions for the future, 2007 [8]

Some main conclusions of the review are:

- The Marine Strategy and the EU ICZM policy are to be also considered in the broader framework of the future EU Maritime Policy. As the geographical scope of

the maritime policy proposed in this Green Paper includes the coastal zones, Integrated Coastal Zone Management has a role to play in the policy framework proposed. Moreover, given the particular exposure of coastal zones to the possible impacts of climate change, the second European Climate Change Programme, in particular its part on impacts and adaptation, and the proposed Green Paper on Adaptation to Climate Change, are also of key importance to Europe's coastal zones.

- The on-going inter-institutional discussions on the proposed Marine Strategy Directive, the results from the public consultation launched with the Green Paper on Maritime Policy, which will last until June 2007, and the emerging EU policy on adaptation to climate change will need to be taken into account when devising policy options following the evaluation of the EU ICZM Recommendation.

- The Commission notes that the national ICZM reports provide only limited indications of effective implementation mechanisms. Turning the strategies into reality and significantly advancing ICZM in Europe will require continued and effective implementation efforts. Securing sufficient funding to support the strategies is one part of the challenge. A more fundamental problem remains achieving effective long-term support and commitment for integration in a context of predominantly sectorally organised administrations. ICZM also tends to involve more environmental constituencies, whereas sustainable economic development and social considerations need to be taken on board as well in the strategies.

- A key achievement of the EU ICZM Recommendation has been to codify a common set of principles that should underlie sound coastal planning and management. While the evaluation confirms the relevance of these ICZM principles, the implementation of the EU ICZM Recommendation also reveals varying interpretations and understanding of ICZM across Europe. To foster a more coherent and effective implementation of ICZM, the principles need to be made more operational and better communicated. The diversity of coasts, along with the different administrative systems between and within Member States, implies though that there are no readily available, one-size-fits-all solutions. Rather there is a need for a more systematic comparative analysis and increased exchange of experiences in Europe.

- A methodology to link the efforts in ICZM to trends in sustainability is still lacking.

- To support the implementation of ICZM, more investment will be needed in the capacity to gather information, analyse it and inform the relevant decision-makers and the public at large. The recently adopted INSPIRE Directive[4] provides the legal framework for a more effective infrastructure for the use and dissemination of spatial information. The Shared Environmental Information System which is being developed by the Commission, the European Environment Agency and the Member States in the context of INSPIRE should assist in making coastal zone information more readily available.

- The current EU ICZM Recommendation remains valid to support the implementation of the national strategies and to further ICZM along Europe's coast. A new specific legal instrument to promote ICZM is not foreseen.

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[4] *Directive 2007/2/EC of the European Parliament and of the Council, OJ L 108 of 25.04.2007.*

- The Commission will continue to ensure coherence and synergies among the many EU policies and instruments that affect the coastal zones, so that the implementation at the lower levels of governance is facilitated.

- Concerning specific coastal risks, coastal flooding is covered by the proposed Directive on the assessment and management of floods[5].

Directions for further promotion of ICZM in Europe:
- To achieve a more coherent understanding and implementation of ICZM across Member States, guidance needs to be developed to clarify the principles underlying sound coastal zone planning and management and ways to operationalise them.

More efforts are needed for comparative analyses and the communication and promotion of good practices regarding ICZM, including between coastal regions. The gathering of relevant data and effective information sharing and -use in policy and decision-making also needs to be furthered. The development of common indicators and a framework to assess the effectiveness and efficiency of ICZM will need to be continued.

ICZM Working group on indicators and data [6]

In the 'Report on the use of the ICZM indicators' the following conclusions are mentioned (see Appendix 3 for elaborated text):
- Four functions of indicators are recognized:
  - Data collecting / monitoring (to know trends and collect information about coastal processes)
  - Communication (raising awareness)
  - Assessment for policy or management evaluation
  - Support to decision making
- Important progress has been made in the development of ICZM indicators, both for measuring sustainable development at the coast and progress in ICZM. This development is stimulated by the ICZM recommendations and has been supported mainly by Member States, some regions (especially federal governments), ETC-TE and EEA in the framework of the activities of the EU ICZM Expert Group (esp. the Working group on Indicators).
- There is great potential for the application of indicators, however still important weaknesses are observed:
  - There is limited recognition and awareness of the functions (use) of indicators.
  - So far the context of their construction is rather technical and do not show the political pertinence they should have.
  - Used mainly for monitoring and communication, indicators should be much more oriented towards assessment and evaluation of policy, and in the decision making process.
- The EUROSION project, completed in 2004, developed indicators to establish the Radius of Influence of Coastal Erosion (RICE) (see Appendix 8).

N.B. Further testing of the approved EU indicators to measure the progress in ICZM in Europe was carried out in the COREPOINT project (2008) (see http://corepoint.ucc.ie/).

[5] *COM(2006) 15 final, 18.1.2006.*

State-of-the-coast assessment (2006) [10]

In this report is referred to the results of the EUROSION project, especially by presenting EUROSION maps and data. Some conclusions about coastal erosion management are also in line with the EUROSION findings and recommendations:

- The sustainability of sediment balance is an important challenge for Europe's coastal zones. However, it should be viewed in the wider context of sustainable river management, sea level rise and increasing coastal erosion impacts on the shoreline and intertidal areas. Improving coastal resilience by restoring the sediment balance will require identifying areas where essential sediment processes occur, and establishing 'strategic sediment reservoirs' from where sediment can be taken without endangering the natural balance.

- In terms of a management strategy, the main objective should be to shift from coastal defence and beach management to sediment management. Modern methods of 'soft' coastal engineering that reinforce natural buffers against the rising tides, such as dunes and salt marshes and the protection of key sources of sediment, will help maintain coastal sediment balance and the stability of coastal systems (EEA, 2005).

In the annex about ‘Data and methodological approaches’ the following is mentioned:

- The diversity of Europe's coasts is represented by the variability of coastal systems and management models at different administrative levels (see figure 1 below). This creates the need for multiple approaches in the assessment of the state of the environment within coastal zones. Some indicators may maintain their relevancy regardless of geographic scales span from local to EU level (e.g. hazardous substances in water). Others may be crucial to local level but not EU level (e.g. coastal defence systems). Some issues are best assessed at EU level because the situation needs to be generalised and reasonably aggregated to make it relevant for EU policies (e.g. urban sprawl and urban thematic strategy or sustainable development strategy). This creates the need for separate, but still coordinated assessment levels on an EU and local/regional scale. EU level context needs case studies and local data for the validation of guidelines and recommendations. Local and regional assessments need to be viewed within the broader framework and assistance is needed to recognize the local impacts of EU policies.

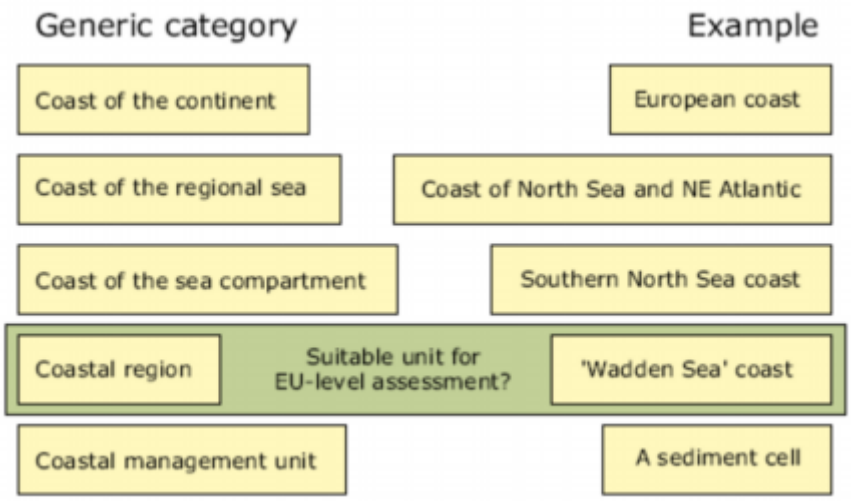

Figure 1 Coastal assessment region in the coastal spatial assessment hierarchy

SAFECOAST findings and recommendations (2008) [11]

By continuing, intensifying and expanding current management practices it is expected that most of the North Sea flood prone areas could be kept safe at acceptable risk levels and at acceptable costs, under presently assumed trends in climate change. In achieving this, the findings of SAFECOAST effectively point towards the need for a more *integrated* approach to coastal risk management, where the main aspects of integration would include: different types of problems, developments, stakeholders, solutions, and types and scales of planning. Recommendations following these main findings are categorised for different target groups related to coastal policy makers and managers and the various research communities:

Policy and management

- Make use of the full potential of measures considered within the risk management cycle or 'safety chain'.
- Clearly define national and regional coastal risk management goals in a broad and long-term perspective.
- Increase the focus of coastal planning procedures at the participation of local communities and authorities.
- Continue the international cooperation and learning process.

Research communities

- Further develop the integrated planning approach to manage coastal risks.
- Improve the knowledge base on the aspects and impacts of climate change.
- Continue the exchange of knowledge for development and further improvement of risk assessment methodologies.
- Reduce, make explicit and better manage uncertainty in coastal flood and erosion risk assessments.

Some detailed findings and recommendations:

- At present, coastal flood risk management is influenced by societal concern for climate change in many North Sea countries. As a result, in most of the North Sea countries a rise of government spending on coastal flood and erosion risk management can be observed. At the same time, due to the absence of recent coastal flood disasters there is a risk of decreasing societal awareness and support for protection measures in specific, flood prone areas. This stresses the need and importance of risk communication and awareness raising to ensure the continuity and support of required coastal risk management strategies.

- From analyses conducted within Safecoast it follows that overall vulnerability and flood risk could substantially increase in the coming 50-100 years. Coastal erosion is a primary driver for coastal flood risks in certain areas. Without counter-measures, gradual coastline retreat puts pressure on inflexible coastal defence structures such as revetments or sea walls. Climate change will exacerbate this trend. Coastal erosion is also an important process to be managed in dune areas that form natural protection of flood prone areas. The results of Safecoast Action 5A on Danish coastal erosion have emphasised the need to include the results of local erosion assessments in decision-making regarding long term adaptation measures.

- Within the measure categories 'Protection' and 'Prevention', many new ideas and concepts have emerged and are being developed in different North Sea countries. Examples of observed trends related to such new ideas and innovative concepts include:

- The development of various **sediment management principles** regarding the designation and maintenance of strategic sediment 'reservoirs' ('sand motor', passive drainage, salt marsh recharge). Such reservoirs would act as buffer zones directly protecting land from the sea, or aiming to secure sufficient sediment volumes within active coastal sediment cells to allow the shore to keep pace with sea level rise.
- Increasing incentives to better incorporate flood and erosion risks and vulnerability into the spatial planning process to avoid or manage unsustainable developments, e.g. discussions on revising coastal and flood risk planning policies in England, but also in other countries.

• Reduce and better manage uncertainty in coastal flood and erosion risk assessments. Further research should aim to understand and identify methods to explicitly include uncertainty in all decisions relating to coastal management. Major uncertainties are related to 1) natural and human induced variability and 2) knowledge uncertainty. Scenario analysis should be applied to manage uncertainty by making the effects of uncertainties explicit and transparent. This does not take away the uncertainties but provides a basis to 'minimise' the risk of making wrong decisions.

ICZM Protocol in the Mediterranean (2008) [9]

Article 23 COASTAL EROSION

In conformity with the objectives and principles set out in Articles 5 and 6 of this Protocol, the Parties, with a view to preventing and mitigating the negative impact of coastal erosion more effectively, undertake to adopt the necessary measures to maintain or restore the natural capacity of the coast to adapt to changes, including those caused by the rise in sea levels.

The Parties, when considering new activities and works located in the coastal zone including marine structures and coastal defence works, shall take particular account of their negative effects on coastal erosion and the direct and indirect costs that may result. In respect of existing activities and structures, the Parties should adopt measures to minimize their effects on coastal erosion.

The Parties shall endeavour to anticipate the impacts of coastal erosion through the integrated management of activities, including adoption of special measures for coastal sediments and coastal works.

The Parties undertake to share scientific data that may improve knowledge on the state, development and impacts of coastal erosion.

2.3 Erosion management concepts: EUROSION project

2.3.1 Aim (what)

The overall aim of the EUROSION is to provide quantified evidence on coastal erosion in Europe, on the problems caused by it and on the successes and failures of mitigation measures. EUROSION also aims at formulating a set of proposals to bring coastal erosion into the mainstream of coastal management at the European, national, regional and local levels [12].

2.3.2 Approach (how)

To meet this aim EUROSION delivered [12]:

- a report with major finding and policy recommendations
- a pan-European database with 60 case studies (1:100,000) assessing the state of the coast and indicators to determine the sensitivity to the risk of coastal erosion
- a shoreline management guide including best practices and lessons learned
- guidelines for SEA/EIA-procedures, cost-benefit analysis and risk assessments
- guidelines and a prototype for a local information system (1:25,000) for erosion planning and management at the local to regional scale;
- methodology for assessing regional indicators

2.3.3 Conclusions and recommendations regarding further implementation

EUROSION findings [12]

Finding 1: Shortages of space and sediments, broad occurrence of “coastal squeeze”

- Urbanization limits space for coastal zones to adjust
- Shortage of sediments induced by human activities (along the coast and in river basins)
- Depletion of natural areas (dunes and marshes)

Finding 2: Possible mitigation measures are not integrated in to the project design

- EIA procedures not adapted to address coastal erosion adequately
- Cost of coastal erosion management has increased
- Natural sites (including NATURA 2000) suffer as sources of sediments to compensate the loss

Finding 3: Awareness of risks lacks presence in planning, related costs are carried by society, benfits by a small group.

- Cost of coastal erosion risk is mainly supported by the public
- Risk assessment is poorly incorporated in spatial planning practices
- “Risk Information” towards the public remains poor and/or is not legally “binding”

Finding 4: On the mitigation of coastal erosion

- Knowledge of coastal processes limited
- Impact “traditional” measures limited, or generated new problems
- Mitigation measures implemented as piecemeal solutions and not planned with a broad time and space horizon
- Compensation for loss of lands or property implementation suffers administrative obstacles

Finding 5: On information management

- Information lacks support appropriate decisions
- Information shortcomings:
  (i) fragmentation of data sources,
  (ii) duplication of data production efforts,
  (iii) reluctance to release information,
  (iv) poor archiving and dissemination capacities
- Major deficits:
  (i) impact of investment on shoreline stability,
  (ii) coastal erosion risk assessment, and
  (iii) cost-benefit assessment of coastal erosion mitigation measures

EUROSION Recommendations [12]

1. Restore the sediment balance and provide space for coastal processes
- Consider legal process to designate strategic sediment reservoirs (either offshore, alongshore, or inland) outside NATURA 2000 sites (EU level)
- Propose introduction of the concept of favourable sediment status into future EU legislation by amending existing directives or a specific directive on sediment management (EU level)
- Evaluate status of NATURA 2000 sites towards coastal erosion and provide measures to make sure NATURA 2000 sites are not used as a source of sediments to compensate the chronic deficit of sediments (Member state level)

2. Internalise coastal erosion cost and risk in planning and investment decisions
- Make coastal erosion a mandatory topic for: (Member state level)
  - EIA/SEA relating to land reclamation projects (incl. harbour extension) and aggregate extraction activities
  - SEA relating to river district management plans, tourism development plans, and coastal defence programmes
- Implement financial mechanisms to transfer the cost of project/plan/programme impacts on coastal erosion to the project/plan/programme developer ("polluter pays" principle) (Member state level)
- Discourage investments in areas at risk of coastal erosion through the production and dissemination of large scale risk maps (e.g. 1:25,000) and their integration into local spatial plans (Local level)

3. Make responses to coastal erosion accountable
- Optimize investment costs against values at risk and increase social acceptability
- Promote the development of Shoreline Management Plans and Coastal Sediment Management Plans for vulnerable coastal zones (EU, Member state, local level) :
  - under the responsibility of regional authorities
  - elaborated at the level of coastal sediment cells
  - elaborated and implemented in accordance with ICZM principles (notably working with nature, public participation, broad time perspective, local specificities, reporting)

4. Strengthen the knowledge base of coastal erosion management and planning
- Ensure a regular monitoring of exposure of the European coastline to coastal erosion with the participation of regions (EU and regional level)
- Support the (standardized) delineation of coastal sediment cells (EU, Member state level)
- Orient future research and interregional cooperation on: (Member state level)
  - Joint elaboration of Shoreline Management Plans / Coastal Sediment Management Plans and support exchange of experience
  - Development of best practices for incorporating coastal erosion into Environment Assessment (EIA/SEA)
  - Development of best practices for mapping coastal erosion risk at local level
  - Improvement of cost-benefit analysis methods
  - Design of innovative engineering techniques for mitigating coastal erosion
  - Effects of sea level rise on wetlands erosion, storm frequency and storm amplitude

- Develop coastal information governance strategies at local level and encourage the use of interoperable local information systems to support decision making in the fields of coastline management (regional/local level)

2.4 Summary of EU ICZM principles, status of implementation and proposed actions

The following table 1 summarizes the main points of paragraphs 2.1 – 2.3: the EU ICZM principles/concepts, their current status of implementation and proposed follow-up actions.

This table illustrates also the relation between the sustainable development principles, ICZM principles and the EUROSION concepts. The sustainable development principles can be considered as a broad framework for coastal erosion management, referring to environmental protection, policy integration, use best available knowledge, precautionary principle and involvement of citizens. The ICZM principles focus on the coastal zone, working with natural processes, adaptive management based on scientific basis and local (coastal) specificity. The EUROSION concepts address coastal erosion rather specific in terms of coastal resilience, coastal sediment cells, favourable sediment status, and strategic sediment reservoirs. In other words the EUROSION concepts are elaborated in the framework of ICZM, which is part of the overall sustainable development framework and principles.

Based on this overview it can be concluded that for coastal erosion management many preparatory activities have been done, but the EUROSION concepts are still to be implemented in the EU member states. In the next chapter is elaborated how this is taken forward by the CONSCIENCE project.

Table 1 Overview of EU ICZM principles/concepts, status of implementation and proposed actions

Principles / concepts		Current products / status of implementation	Proposed actions / recommendations (as mentioned in literature)
SUST. DEV.	Key objectives: • Environmental protection, social equity and cohesion, economic prosperity, meeting our international responsibilities Policy guiding principles: • Involvement of citizens, business and social partners, policy integration, use best available knowledge, precautionary principle, etc. [1]	• Sustainable Development Strategy 2006 • ECCP II • Progress 'on the ground' is modest but policy development at both EU and Member State level has progressed significantly in many areas, notably on climate change and clean energy • Almost all Member States have now adopted national climate change strategies. Some have set up specific offices and scientific councils [1, 2, 3]	• Continued attention needs to be paid to implementation in all priority areas of the SDS (key challenges) • Continued attention is needed for developing climate change adaptation strategies and plans • Work on climate change in the coastal zone could be integrated with an understanding of the overall coastal policies in operation [2, 3]
ICZM	ICZM principles / recommendations: • Broad and long-term perspective, precautionary principle, adaptive management based on scientific basis, local specificity, working with natural processes, involvement of all stakeholders, coordination of existing policies, partnerships, use of a combination of instruments [4, 5]	• National strategies to implement ICZM • ICZM process indicators/ Sustainability indicators • Protocol on ICZM in the Mediterranean (including article 23 on Coastal Erosion) • Green Paper on Maritime Policy • Emerging EU policy on adaptation to climate change • Proposed Marine Strategy Directive • FP5 / FP6 / FP7 projects • INTERREG projects [6-12]	• Continued and effective implementation efforts by mainstreaming of EU policies (a.o. EU Maritime Policy and EU directives), sufficient funding, long-term support and commitment for integration taking into account local specificity • Elaborate the strategic approach of ICZM by a practical framework; the ICZM principles need to be more operational and better communicated • Raise the profile of ICZM at all levels (from EU-level to local level) by awareness raising, guidance, training, stakeholder fora, etc. • More integrated approach to coastal risk management (incl. climate change); define national and regional coastal risk management goals. N.b. coastal flooding is covered by the Flood Directive • Improve the knowledge base (and exchange) regarding ICZM and the impacts of climate change • Develop decision support tools for policy makers and practitioners • Harmonize monitoring and evaluation frameworks (incl. indicators, data collection, risk registry) • Further develop common indicators to assess ICZM effectiveness and efficiency; improve awareness and practical use of indicators, especially for assessment and evaluation of policy, and for decision making • More effective infrastructure for use and dissimination of spatial information (a.o. by the INSPIRE directive) • Comparative analysis and increased exchange of experiences (EU contract

Principles / concepts		Current products / status of implementation	Proposed actions / recommendations (as mentioned in literature)
			commissioned by Dec 2008) [6-12]
EUROSION	EUROSION concepts: • coastal resilience • coastal sediment cells • favourable sediment status • strategic sediment reservoir EUROSION recommendations: • Restore the sediment balance and provide space for coastal processes • Internalise coastal erosion cost and risk in planning and investment decisions • Make responses to coastal erosion accountable • Strengthen the knowledge base of coastal erosion management and planning [12]	• Shoreline Management Guide SMG (incl. best practices and lessons learned) • Database with 60 cases studies • Guide on management of coastal information • Guidelines for SEA/EIA-procedures • Guidelines for cost-benefit analysis • Guidelines for coastal risk assessment • Guidelines for local information systems • Methodology for assessing regional indicators • EEA State-of-the-coast assessment 2006 (EUROSION concepts are mentioned) • INSPIRE directive [12]	Recommendations: • Disseminate EUROSION concepts and SMG widely • Incorporate EUROSION concepts and recommendations in EU policies, directives and EU-projects (a.o. Maritime Policy, INSPIRE, GMES, Interreg) • Designate strategic sediment reservoirs (optimize with N2000) • Enact 'favourable sediment status' in EU legislation • Improve cost and risk planning; make 'coastal erosion' a mandatory topic in SEA/EIA • Implement financial mechanisms regarding coastal erosion • Make risk maps and integrate with local spatial plans • Promote development of SMP/CSMPs; shift from coastal defence and beach management to sediment management; standardize delineation of coastal sediment cells • Ensure regular monitoring of coastal erosion (EEA) • Develop coastal information strategies to support decision making (a.o. by local information systems) • Stimulate research on coastal erosion issues [12]
	C O N S C I E N C E		

3 Further implementation of the EUROSION concepts by CONSCIENCE

3.1 Aim and approach of CONSCIENCE

3.1.1 Aim (what)

A major issue in many parts of European coasts is the problem of coastal erosion and associated risks. The scope and urgency of this problem was comprehensively studied and described by the EUROSION project. The challenge for CONSCIENCE is now to help implementing the recommendations of the EUROSION project in the framework of ICZM.

3.1.2 Approach (how)

Implementation of an overall policy framework for sustainable coastal erosion management requires an operational set of concepts and methods that can be used by a coastal manager. And it is here that CONSCIENCE finds its justification: it provides guidelines and tools to the manager to implement the four main elements of the policy as recommended by the EUROSION project:

- Increase coastal resilience by restoring the sediment balance and providing space for coastal processes
- Incorporating coastal erosion costs and risks in existing planning and policy instruments
- Make responses to coastal erosion accountable
- Strengthening the knowledge base of coastal erosion management and planning

The Frame of Reference for coastal management will assist managers to define relevant parameters to qualify and quantify coastal resilience and favourable sediment status.

The Frame of Reference discerns four basic steps in policy making, viz.:

- Quantitative state concept: a means of quantifying the problem in hand. Coastal state indicators (CSIs; i.e specific parameters that play a role in decision making) are relevant at this stage of the process.
- Benchmarking process: a means of assessing whether or not action is required. CSIs are compared to a threshold value at this stage.
- Intervention procedure: A detailed definition of what action is required if the benchmark values are exceeded.
- Evaluation procedure: Impact assessment of the action taken. If the action was not successful it may be necessary to revise the strategic/operational objectives (hence the feedback loops in Figure 2).

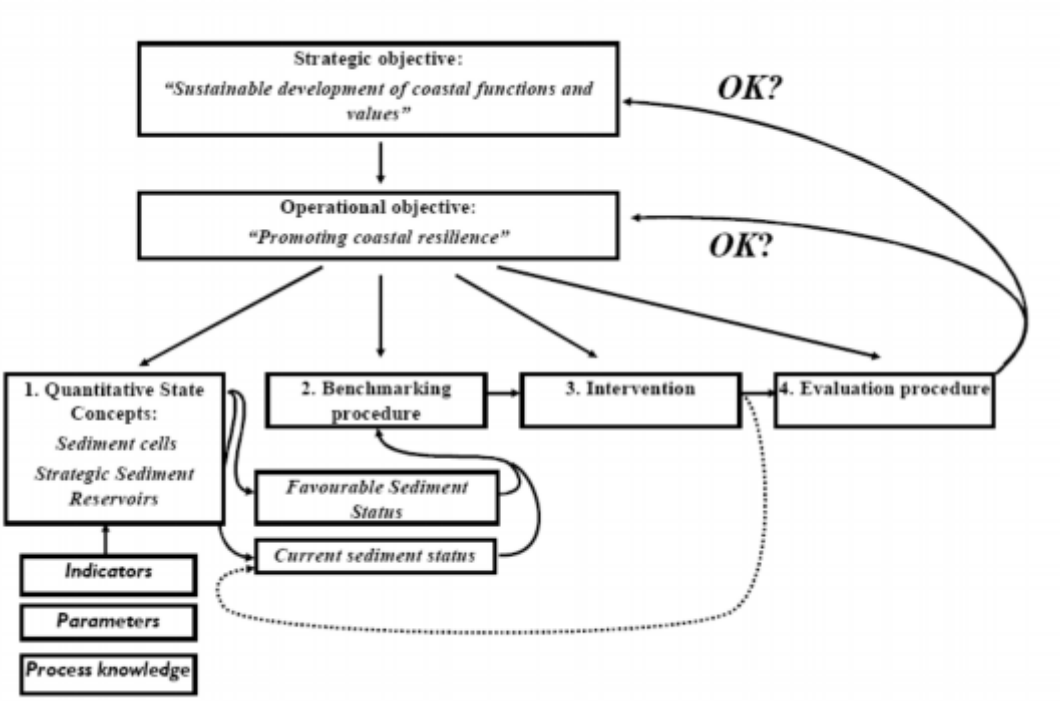

Figure 2 Frame of Reference for implementing the coastal erosion management policy

3.2 Overview of actions needed and the role of CONSCIENCE

The CONSCIENCE Frame of Reference is introduced as a framework for the further implementation and development of the EUROSION concepts of coastal erosion management based on sustainability and ICZM principles.

Table 2 gives a summarized overview of all actions needed, referred to the CONSCIENCE Frame of Reference and incorporating the issues mentioned in table 1. In line with the Erosion project 3 levels of implementation are recognized: the EU level, Member state level and Coastal region level.

Table 2 Overview of actions needed to further implement the EUROSION concepts referring to the CONSCIENCE Frame of Reference (based on table 1)

CONSCIENCE Frame of Reference	**Implementation actions needed**		
	EU level	**Member State level**	**Coastal region level**
Strategic objectives • Sustainable development	• Incorporate EUROSION concepts and recommen-dations in EU policies, directives and EU-projects (a.o. Maritime Policy, INSPIRE, GMES, Interreg);	• Incorporate EUROSION concepts in national ICZM strategies and in national climate change strategies • Make use of the Protocol on ICZM in the Mediterranean	
Operation objectives • Coastal resilience	• Implement financial mechanisms regarding coastal erosion • Promote development of SMP/CSMPs; n.b. shift from coastal defence and beach management to sediment management	• Improve cost and risk planning; make 'coastal erosion' a mandatory topic in SEA/EIA • Address more clearly the issue of coastal erosion in climate change adaptation strategies (ECCP II) and coastal risk strategies/plans	• Make risk maps and integrate with local spatial plans • Implement guidelines for the preparation of coastal erosion plans (incl. EUROSION SMG) • Develop SMP/CSMPs; n.b. shift from coastal defence and beach management to sediment management • Make use of the EUROSION database with 60 case studies and use other experiences • Implement the EUROSION guidelines for SEA/EIA, cost-benefit analysis and coastal risk assessment
Quantitative State Concepts • Sediment cell • Strategic sediment reservoir	• Improve the knowledge base (and exchange) regarding coastal erosion, ICZM and impacts of climate change (by FP7, INTERREG, etc.) • Standardize delineation of coastal sediment cells • Implement guidelines for definition of setback lines • Improve awareness	• Delineation/designation of coastal sediment cells and strategic sediment reservoirs (optimize with N2000) • Develop coastal information strategies to support decision making (a.o. by local information systems)	• Implement (improved) erosion model and (DSS) tools to support policy makers and practitioners • Implement EUROSION Guide on management of coastal information and guidelines for local information systems • Implement EUROSION

CONSCIENCE Frame of Reference	Implementation actions needed		
	EU level	**Member State level**	**Coastal region level**
	and practical use of indicators, especially for assessment and evaluation of policy, and for decision making		methodology for assessing regional indicators • Implement ICZM process indicators / Sustainability indicators
Benchmarking procedure • Favourable sediment status • Current sediment status	• Enact 'favourable sediment status' in EU legislation	???	???
Intervention	???	???	???
Evaluation	• Ensure regular monitoring of coastal erosion (EEA) • Harmonize monitoring and evaluation frameworks (incl. indicators, data collection, risk registry) • Establish a more effective infrastructure for use and dissemination of spatial information (a.o. by the INSPIRE directive)*	• Implement monitoring guidelines	• Implement monitoring guidelines • Implement ICZM process indicators / Sustainability indicators
Governance issues	• Disseminate EUROSION concepts and guidelines (a.o. Shoreline Management Guide SMG) and raise the profile of ICZM by awareness raising, guidance, training, stakeholder fora, etc.	• Disseminate EUROSION concepts and guidelines (a.o. Shoreline Management Guide SMG) and raise the profile of ICZM by awareness raising, guidance, training, stakeholder fora, etc.	• Disseminate EUROSION concepts and guidelines (a.o. Shoreline Management Guide SMG) and raise the profile of ICZM by awareness raising, guidance, training, stakeholder fora, etc.

3.3 Conclusions and recommendations

3.3.1 Conclusions, opportunities and threats

Implementation of the EUROSION concepts
The EUROSION project elaborated coastal erosion management in the framework of sustainable development and ICZM. Many valuable products and recommendations were delivered, but the (further) implementation of the EUROSION concepts seems to be very limited (see table 1 for overview). More generally it is recognized that the principles of sustainable development and ICZM (strategic approach) should be made more operational and better communicated. Continued and effective implementation efforts are needed. However there is much progress on policy and strategy development.

The issue of coastal erosion management is being addressed, but the EUROSION concepts are hardly or not mentioned at all. Obviously there are much more efforts needed to disseminate, advocate and promote the further implementation of the EUROSION concepts at all levels (EU, Member State, Coastal region). This involves most relevant policies, directives, strategies and plans, especially the Maritime Policy, Climate Change Strategy, Urban Strategy, EIA/SEA Directives, Nature Directives, Flood Directive, Soil Directive and Soil Strategy, Shoreline Management Plans and Coastal Sediment Management Plans.

Implementation can be supported by monitoring and decision support tools for policy makers and practitioners. The practical use of indicators is recognized to be valuable for assessments, evaluation and decision making. The improvement of the knowledge base (and exchange) regarding coastal erosion is also needed.

The CONSCIENCE Frame of Reference is introduced as a framework for the further implementation and development of the EUROSION concepts of coastal erosion management based on sustainability and ICZM principles. Table 2 gives a summarized overview of all actions needed, referred to the CONSCIENCE Frame of Reference.

Opportunities
The current policy and strategy development on climate change adaptation (ECCPII), ICZM and risk management gives ample opportunities at all levels to address more clearly the issue of coastal erosion and the need to implement the EUROSION concepts. The ongoing attention for climate change and related sea level rise will certainly help to raise awareness and build commitment.

Threats
For further implementation of the EUROSION concepts appropriate capacities, commitment and financial resources are needed. Moreover the shift from coastal defence and beach management to sediment management needs a change of thinking, which probably takes additional time.

3.3.2 Recommendations

- As much as possible efforts should be put in awareness raising, advocacy and building commitment for the EUROSION concepts at all levels.

- The Frame of Reference should address and elaborate more clearly the 'Governance' issues in relation to the other issues. 'Intervention' needs also to be more elaborated.
- The EU ICZM website could be improved (http://ec.europa.eu/environment/iczm/) especially by incorporating information on and links with the following:
  - Sustainable Development in Europe (incl. the ECCPII);
  - EUROSION website and products;
  - CONSCIENCE website;
  - The MAP Protocol on ICZM;
  - Relevant European Interreg and research projects (see table A);
  - ENCORA Coastal Wiki, to make linkage with state-of-the-art articles.

4 Literature

1. Review of the EU Sustainable Development Strategy (EU SDS) − Renewed Strategy, Council of the European Union, Note nr. 10917/06, 2006
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3. Progress Report on the Sustainable Development Strategy 2007, EC, COM(2007) 642, 2007
4. Integrated Coastal Zone Management: A Strategy for Europe, EC, COM/00/547, 2000
5. Proposal for a European Parliament and Council Recommendation concerning the implementation of Integrated Coastal Zone Management in Europe, EC, COM/00/545, 2000
6. Report on the use of the ICZM indicators from the WG-ID, a contribution to the ICZM evaluation, version 1, ETC/TE, EEA, 2006
7. Evaluation of Integrated Coastal Zone Management (ICZM) in Europe, Rupprecht Consult, 2006
8. Report to the European Parliament and Council: An evaluation of Integrated Coastal Zone Management (ICZM) in Europa, EC, COM(2007)308
9. Mediterranean Action Program (MAP), Protocol on ICZM, 2008
10. The changing faces of Europe's coastal areas (State-of-the-coast assessment), EEA, 2006
11. Coastal flood risk and trends for the future in the North Sea Region, Results and recommendations of project Safecoast, Synthesis report, 2008
12. EUROSION publications (see Appendix 5)

Websites:

- EU/ICZM: http://ec.europa.eu/environment/iczm/
- EUROSION: http://www.eurosion.org/
- SAFECOAST: http://www.safecoast.org/
- ECCP: http://ec.europa.eu/environment/climat/eccp.htm
- EU-Sustainable Development Strategy: http://ec.europa.eu/environment/eussd/ or http://ec.europa.eu/sustainable/
- MAP Protocol on ICZM: http://www.pap-thecoastcentre.org/

Appendix 1 ICZM process indicators and Sustainability indicators

ICZM Process Indicators

Phase	Action	Description
Planning and management are taking place in the coastal zone	1	Decisions about planning and managing the coast are governed by general legal instruments.
	2	Sectoral stakeholders meet on an ad hoc basis to discuss specific coastal and marine issues.
	3	There are spatial development plans which include the coastal zone but do not treat it as a distinct and separate entity.
	4	Aspects of the coastal zone, including marine areas, are regularly monitored.
	5	Planning on the coast includes the statutory protection of natural areas.
A framework exists for taking ICZM forward	6	Existing instruments are being adapted and combined to deal with coastal planning and management issues.
	7	Adequate funding is usually available for undertaking actions on the coast.
	8	A stocktake of the coast (identifying who does what, where and how) has been carried out.
	9	There is a formal mechanism whereby stakeholders meet regularly to discuss a range of coastal and marine issues.
	10	Ad hoc actions on the coast are being carried out that include recognisable elements of ICZM.
	11	A sustainable development strategy which includes specific references to coasts and seas is in place.
	12	Guidelines have been produced by national, regional or local governments which advise planning authorities on appropriate uses of the coastal zone.
Most aspects of an ICZM approach to planning and managing the coast are in place and functioning reasonably well	13	All relevant parties concerned in the ICZM decision-making process have been identified and are involved.
	14	A report on the State of the Coast has been written with the intention of repeating the exercise every five or ten years.
	15	There is a statutory integrated coastal zone management plan.
	16	Strategic Environmental Assessments are used commonly to examine policies, strategies and plans for the coastal zone.
	17	A non-statutory coastal zone management strategy has been drawn up and an action plan is being implemented.
	18	There are open channels of communication between those responsible for the coast at all levels of government.
	19	Each administrative level has at least one member of staff whose sole responsibility is ICZM.
	20	Statutory development plans span the interface between land and sea.
	21	Spatial planning of sea areas is required by law.
	22	A number of properly staffed and properly funded partnerships of coastal and marine stakeholders have been set up.
	23	Coastal and estuary partnerships are consulted routinely about proposals to do with the coastal zone.

	24	Adequate mechanisms are in place to allow coastal communities to take a participative role in ICZM decisions.
An efficient, adaptive and integrative process is embedded at all levels of governance and is delivering greater sustainable use of the coast	25	There is strong, constant and effective political support for the ICZM process.
	26	There is routine (rather than occasional) cooperation across coastal and marine boundaries.
	27	A comprehensive set of coastal and marine indicators is being used to assess progress towards a more sustainable situation.
	28	A long-term financial commitment is in place for the implementation of ICZM.
	29	End users have access to as much information of sufficient quality as they need to make timely, coherent and well-crafted decisions.
	30	Mechanisms for reviewing and evaluating progress in implementing ICZM are embedded in governance.
	31	Monitoring shows a demonstrable trend towards a more sustainable use of coastal and marine resources.

Sustainability indicators

No	Indicator	code	Measurement
1	Demand for property on the coast	1.1.	Size and proportion of the population living in the coastal zone
2	Area of built-up land	2.1.	Percent of built-up land by distance from de coastline
3	Rate of development of previously undeveloped land	3.1.	Percent of new development on previously developed land
		3.2.	Area converted from non-developed to developed land use
4	Demand for road travel on the coast	4.1.	Volume of traffic on coastal motorways and major roads
5	Pressure for coastal and marine recreation	5.1.	Number of berths and moorings for recreational boating
6	Land take by intensive agriculture	6.1.	Proportion of agricultural land farmed intensively
7	Area of semi-natural habitat	7.1.	Area of semi-natural habitat
8	Area of land and sea protected by statutory designations	8.1.	Area protected for nature conservation, landscape or heritage
9	Effective management of designated sites	9.1.	Rate of loss of, or damage to, protected areas
10	Change to significant coastal and marine habitats and species	10.1	Status and trend of specified habitats and species
		10.2	Number of species per habitat type
		10.3	Number of Red List coastal area species
11	Lost of cultural distinctiveness	11.1	Number and value of sales of local products with regional quality labels or European PDO/PGI/TSG
12	Patterns of sectoral employment	12.1	Full time, part time and seasonal employment per sector
		12.2	Value added per sector
13	Volume of port traffic	13.1	Number of incoming and outgoing passengers per port
		13.2	Total volume of goods handled per port
		13.3	Proportion of goods carried by short sea routes
14	Intensity of tourism	14.1	Number of overnight stays in tourist accommodation
		14.2	Occupancy rate of bed places
15	Sustainable tourism	15.1	Number of tourist accomodations holding EU Eco-label
		15.2	Ratio of overnight stays per number of residents
16	Quality of bathing water	16.1	Percent of coastal bathing waters compliant with the guide value of the European Bathing Water Directive
17	Ammount of coastal, estuarine and marine litter	17.1	Volume of litter collected per given length of shoreline
18	Concentration of nutrients in coastal waters	18.1	Average winter concentrations of nitrates and phosphates in coastal waters
19	Amount of oil pollution	19.1	Volume of accidental oil spills
		19.2	Number of observed oil slicks from aerial surveillance
20	Degree of social exclusion	20.1	Indices of multiple deprivation by area
21	Relative household prosperity	21.1	Average household income
		21.2	Percent of population with a higher education qualification
		21.3	Value of residential property
22	Number of second homes	22.1	Ratio of first to second homes
23	Fish stocks and fish landings	23.1	State of the main fish stocks by species and sea area
		23.2	Recruitment and spawning stock biomass by species
		23.3	Landings and fish mortality by species
		23.4	Value of landings by port and species
24	Water consumption	24.1	Number of days of reduced supply
25	Sea level rise and extreme weather conditions	25.1	Number of 'stormy days'
		25.2	Rise in sea level relative to land
26	Coastal erosion and accretion	26.1	Length of protected and defended coastline
		26.2	Length of dynamic coastline
		26.3	Area and volume of sand nourishment
27	Natural, human and economic assets at risk	27.1	Number of people living within 'at risk' zone
		27.2	Area of protected sites within 'at risk' zone
		27.3	Value of economic assets within 'at risk' zone

Appendix 2 Overview of ICZM evaluation recommendations and actions

Strategic recommendations

1. Strengthen the European dimension of ICZM based on a Regional Seas approach
Follow the EEA recommendation of regionalisation and enhance ICZM activities on a supra-national level, providing a common European frame to help bringing actors together, building capacities and harmonising practices in a trans-national perspective.

2. Raise the profile of ICZM and enhance its integration with sectoral policies
Enhance stakeholders' identification with ICZM, create a cross-sectoral policy community from EU to local level and ensure incorporation of ICZM into current practices.

3. Elaborate the strategic approach of ICZM - oriented at a balanced ecologic, social, economic and cultural development
Develop a common conceptual framework describing the geographical delimitations, development orientations, stakeholder responsibilities, and procedures to be followed, linking the EU ICZM recommendation and stakeholder routines in a practical way.

4. Address major long-term risks: Vulnerability to disasters and climate change Include the vulnerability of the coast to disasters as well as consequences of climate change, sea level rise and pollution on a Regional Sea level and in a long-term perspective, striving for the adoption of the precautionary principle.

Recommendations and actions

5. Endorse awareness, guidance, training and education
Raise awareness among coastal stakeholders by making better use of all instruments of information dissemination. Provide guidance and develop human capacities through education and training. Support ICZM training centres, staff exchange opportunities, university courses and advanced adult education.

Actions
5.1 Raise awareness and promote ICZM
5.2 Provide guidance on the preparation and performance of ICZM
5.3 Support the establishment of ICZM training centres of excellence
5.4 Offer possibilities for staff exchange between different regions and countries
5.5 Review, endorse and promote academic courses on ICZM

6. Enhance stakeholder coordination and participation
Obtain a more comprehensive overview and insight of current ICZM practices in Europe. Establish an ICZM Advisory Board and create open stakeholder fora at European, Regional Sea and national levels to facilitate cross-sectoral stakeholder participation. Build on existing organisations and practices for implementation.

Actions
6.1 Complete the stocktake exercise in due time
6.2 Set up an ICZM advisory board at European level
6.3 Create ICZM stakeholder fora at national, Regional Seas and European levels
6.4 Build on existing organisations and practices, but modify these where necessary

7. Perform a mainstreaming of European policies
Incorporate ICZM in all pertinent programmes and instruments regarding their orientation (objectives) and the provision of funds. Clarify the role and relationship of the different policies and instruments in ICZM for all stakeholders.

Actions
7.1 Make clear the practical role of relevant policy strategies and regulation affecting ICZM
7.2 Incorporate ICZM in all pertinent funding instruments regarding their orientation and the conditioning of funds.

8. Harmonise monitoring and evaluation frameworks
Draw up a baseline from a sustainable development perspective, including a risk registry. Harmonise methodologies and indicators, data collection and exchange arrangements. Monitor implementation progress and carry out a long-term evaluation.

Actions
8.1 Establish a common baseline for coastal zone development in Europe
8.2 Harmonise monitoring and assessment methodologies and indicators
8.3 Improve data collection and exchange
8.4 Monitor ICZM implementation and carry out a long-term evaluation

9. Improve the knowledge basis for ICZM
Support ICZM research, in particular by linking into relevant action lines of FP7, and provide priority funding for projects fully in line with the principles of good ICZM. Promote learning from good and bad practices and tools to support decision making. Create a single European ICZM knowledge centre.

Actions
9.1 Strengthen the ICZM component in FP7 research programmes
9.2 Evaluate coastal management project results and experiences
9.3 Develop and demonstrate suitable decision support systems (DSS) for policy makers and practitioners
9.4 Create a common knowledge centre

Appendix 3 Status of ICZM indicators (Sept, 2006)

In the 'Report on the use of the ICZM indicators from the WG-ID' the following conclusions are mentioned:

Since the ICZM Recommendation in 2002:

- Important progress has been done in the development of ICZM indicators (both for measuring sustainable development at the coast and progress in ICZM). This development has been supported mainly by Member State, by some regions (especially in federal governments) and also by ETC-TE and EEA in the framework of the EU ICZM Expert Group and its WG-ID.
- In the application of these indicators for monitoring, countries such Belgium, Netherlands, France and Spain have already developed the EU SD indicator set for their ICZM National strategies. Countries such as Poland, Malta and Latvia are doing it in the DEDUCE program. HELCOM will also use the EU SD indicators in its ICZM strategy.
- The EU SD indicator set has been recognised by different EU projects such as COST-ESF, CorePoint, Deduce, etc as a good ICZM indicator basis. Some "critics" expressed the need of testing these indicators. In 2006, it can be said that the testing has been done at different scales for the 27 SD indicators and the ICZM progress indicator, showing very interesting results and allowing strong assessment.
- Some countries, understanding the importance of data gathering and processing and indicator building for the coast, have launched national observatories of the coast (France (2004), Spain (2005)…),
- All these related developments are positive because they ensure that indicators and data are compiled and build in different countries and at different scales but under a **standardised form** (agreed set of indicator, knowledge of data availability and gaps, **agreed methodology of measurement, etc)** assuring comparability around Europe and allowing to identify and put more **effort on the monitoring of data needed**.
- At the same time, this institutionalization of "observatories" or similar allows the updating of indicators along time, with a potential of long time series.
- The work of the EU ICZM Expert Group and of its WG-ID has been the motor of the all process.
- Moreover, ICZM progress indicator shows a clear progress between 2000 and 2005 in the implementation of actions towards ICZM implementation. First and second phases of the process underwent great progress, Phase 3 and 4 needs now major effort to arrive to a fully implemented process. But clearly, process is going on at a pace that can be still quicker if it is supported by the body of existing policies for the coast with much more integrated visions and actions, within the frame of a strong EU ICZM guidance.
- There is a great potential for indicators application, but still important weaknesses are observed:
    - There is not enough recognition and awareness of the functions that indicators can play
    - So far the context of their construction is still far much too technical and do not show the political pertinence they should have.
    - Used mainly for monitoring and communication, indicators should be much more oriented towards assessment and evaluation of policy, and in the decision making process.
    - To be resonant at European level,
        - ICZM indicators needs to have an agreed set and to be standardized in their methodology. That's done. This first step, worked out within the WG-ID since 2003, will be fully implemented in 2007 with the DEDUCE results.
        - ICZM indicators needs to have different functions, from monitoring and communication to assessment and political support and decision making. There are still lots of efforts to do in this direction. But when countries will

understand how this can function, they will really need to develop and use ICZM indicators.

Actions proposed in the country reports to update the SD indicator for the coast

- Update scientific basis of indicators with scientist participation
- Establishment of targets or thresholds, and evaluation of the "distance to target" which should be done with participation of stakeholders to build more stringent "policy assessment" and "management" indicators
- Involve more directly stakeholders in the use of ICZM and SD indicators as a tool to overpass conflicts on the one hand and to be more and more present in the decision making process on the other hand.
- Review the set with possible inclusion of new indicators judged necessary for the implementation of national strategies.

Actions proposed

- On the basis of main results, each EU SD indicators give a diagnosis for an issue or a theme. Results for individual indicators should be compiled and cross analysis should be done. Looking at how much 2 or 3 different indicators can bring together more light on some integrated and cross cutting issues, on the assessment of different coastal policies, with a long term view.
- Moreover, the results obtained on the measure of sustainability trends for the coast should be narrowly compared with the development of the ICZM and the progress assessed. Therefore both sets of indicators are complementary and should make synergies between them, helping to review management and policies.
- Most of the ICZM indicators should be represented in space and integrated in the Land and Ecosystem Accounts (LEAC) developed by EEA, reformulating statistical data in standard grids and in a number of fluxes. This will lead to a powerful database organised spatially and in time scales, and will give a powerful frame to go from diagnosis towards prospective analysis.
- Advance towards thresholds and limits can also be expressed in different scenarios, and through a SWOT analysis, assess if it is or not possible to attain the objective in the relevant time frame.
- Both systems, SWOT analysis on a number of scenarios and the inclusion inside LEAC would greatly help to see in which direction initiatives should go and where the risks are. Indicators need to be useful to assess planning decisions and new ways of managing the coast, to assess also impacts of structural funds, etc.
- Therefore indicators would clearly serve to:
  - Impulse a series of actions oriented to objectives, in a determined scenario
  - Measure the "distance to objective" and review actions, impulsing new directions for evaluation of policy and decision making.
  - Formalize a framework of analysis whose indicator results could be expressed in term of opportunity (best corridors for mobility, green corridors, etc) and risk (socio-economic, environmental, biodiversity and landscape degradation, climate change, technological risks, etc)
- There is also a need to have indicators with different functions:
  - Indicators for monitoring, assessing trends, diagnosis
  - Prospective indicators to help in the decision making
  - Spatial indicators to understand how the territory behaves in time and in function of the different decisions taken.
  - Indicators to assess concrete policies such as structural funds, ESPON (development strategies), etc
- An important step has been done since 2002, but efforts need to be continued. Momentum cannot be lost.
- Recognizing the importance of the work done by the WG-ID to steer indicator development and indicator use in countries and regions and amongst coastal

practitioners, its task, together to the EU ICZM Expert Group, should continue to fully support the continuity of ICZM process.

Appendix 4 Eurosion findings and recommendations

Eurosion findings

Finding 1: on coastal squeeze and the loss of sediment
Urbanisation of the coast has turned coastal erosion from a natural phenomenon into a problem of growing intensity. In many coastal areas erosion problems are now increased by human activities and artificially stabilised seafronts are progressively encroaching on sedimentary coastlines and cliffs. Dynamic ecosystems and their undeveloped coastal landscapes are gradually disappearing, and lack of sediment can be a major contributory factor. In many places 'coastal squeeze' is the manifestation of this phenomenon.

Finding 2: on environmental and economic assessment
Environmental Impact Assessment (EIA) procedures - as implemented under the terms of the directive 85/337/EEC – have been insufficient in addressing the impact of human activities, such as development, on the wider coastal environment. Subsequently, the cost of attempting to reduce coastal erosion has increased considerably in relation to the assets requiring protection. Consequently it has resulted in a need to transfer the cost of coastal erosion mitigation measures to such activities.

Finding 3: on coastal erosion risk
The cost of reducing coastal erosion risk is mainly supported by national or regional budgets, hardly ever by the local community and almost never by the owners of assets at risk or by the party responsible for coastal erosion. This is emphasized by the fact that coastal erosion risk assessment has not been incorporated in decision-making processes at the local level and risk information to the public remains poor.

Finding 4: on the mitigation of coastal erosion
Over the past hundred years the limited knowledge of coastal sediment transport processes at the local authority level has often resulted in inappropriate measures of coastal erosion mitigation. In many cases, measures may have solved coastal erosion locally but have exacerbated coastal erosi on problems at other locations – up to tens of kilometres away – or have generated other environmental problems.

Finding 5: on information management
In spite of the availability of a tremendous amount of data, information gaps continue to exist. The practice of coastal information management – from raw data acquisition to aggregated information dissemination - suffer from major shortcomings, which result in inadequate decisions. Surprisingly, sharing and dissemination of coastal data, information, knowledge and experiences are hardly ever considered by regional and local stakeholders. The use of a better knowledge base when coastal development is proposed provides an opportunity, which would reduce technical and environmental costs of human activities (including measures for coastal erosion mitigation) and could help anticipate future trends and risks.

Eurosion recommendations

Recommendation nr. 1 Restoring the sediment balance and providing space for coastal processes
A more strategic and proactive approach to coastal erosion is needed for the sustainable development of vulnerable coastal zones and the conservation of coastal biodiversity. In light of climate change it is recommended that coastal resilience is enhanced by: (a) restoring the sediment balance; (b) allocating space necessary to accommodate natural erosion and coastal sediment processes and (c) the designation of strategic sediment reservoirs.

1.1. Elaboration at EU-level

EUROSION proposes that the concepts of a 'favourable sediment status' of coastal zones and of 'strategic sediment reservoirs' be introduced within EU legislation. This can be done either by amending existing directives – notably the Water Framework Directive and the Habitats Directive – or by considering the opportunity to develop a specific directive on sediment management. The rationale for recommending further elaboration on the possibility to introduce these concepts at the level of a directive, is that sediment management is a cross-border sector which interacts, and in certain cases conflicts, with the requirements of other existing European directives and policies. These mechanisms should be implemented through the preparation of Coastal Sediment Management Plans (CSMPs) for vulnerable coastal zones.

Soil Strategy: The EC should consider the opportunity to embed the concepts of favourable sediment status and strategic sediment reservoirs for coastal resilience within the preparation of the EU Soil Strategy. This can be done by recognising the contribution of river catchment to the sediment budget and sediment quality within the coastal sediment cell, and therefore by developing within the EU Soil Strategy a specific chapter dedicated to coastal sediment management and coastal erosion. The Soil Strategy may also consider the possibility of recommending the establishment of Coastal Sediment Management Plans (CSMP) as an instrument of the good sediment management. This is further elaborated in recommendation 3.

Common Agriculture Policy: The EC should ensure that the modalities for implementing the concepts of favourable sediment status and strategic sediment reservoirs into the EU legislation do not conflict with requirements of the Common Agriculture Policy, notably those relating to measures taken to reduce soil erosion.

Urban Strategy: the need to make spatial allocations for 'strategic sediment reserves' should be recognised in urban planning strategies for coastal zones vulnerable to erosion. From a resilience point of view sediment reservoirs can be combined with setback zones along the shoreline.

Nature Directives: the extent to which Natura 2000 sites are currently used as sources to supply sediments to compensate chronic deficits of sediments as a result of human intervention should be monitored. It will also be important to consider the effect of allowing the natural dynamic to operate (particularly in realignment schemes) within these sites as this can lead to the replacement of one habitat by another with a potential loss of Favourable Conservation Status in the habitat which is replaced. The way this is approached needs to be considered and guidance given.

1.2. Elaboration at Member States level

Member States should anticipate the proposed introduction of the concepts of favourable sediment status and strategic sediment reservoirs into the EU legislation by providing a national policy framework to coastal resilience and the elaboration of coastal and sediment management plans (CSMP) to achieve coastal resilience. CSMP are further elaborated in recommendation 3.

In particular, the responsibility of Member States for the maintenance of the Natura 2000 network requires that the implications of favourable sediment status and strategic sediment reservoirs on designated habitats and associated species are taken fully into account. In that respect, Member States should ensure that areas designated for nature conservation (Natura 2000) are not used as sources to supply sediments to compensate chronic deficits of sediments as a result of human intervention (in other words, that Natura 2000 sites are not implicitly considered as sediment reservoirs of type 3).

1.3. Elaboration at the level of coastal regions

Local authorities should make use of their planning instruments to ensure the availability of sediments and space for future coastal processes to operate.

Recommendation nr. 2 Internalise coastal erosion cost and risk in planning and investment decisions

The impact, cost and risk of human induced coastal erosion should be controlled through a better internalisation of coastal erosion concerns in planning and investment decisions. Public responsibility for coastal erosion risk should be limited and an appropriate part of the risk should be transferred to direct beneficiaries and investors. Environmental Assessment instruments should be applied to achieve this. Risks should be monitored and mapped, evaluated and incorporated into planning and investment policies.

2.1. Elaboration at EU-level

Soil Strategy: in connection to the elaboration of EUROSION Recommendation nr. 1, the thematic strategy and communication should stipulate the preparation of coastal erosion risk maps and provide guidelines for the integration of soil concerns into spatial planning through the identification of 'strategic sediment reservoirs' and setback zones.

Urban Strategy: see above under par. 1.1. In addition, the need to avoid and control urban sprawl should be stressed. This is important because urban sprawl in risk zones will increase potential damage from erosion and may compromise the identification of strategic sediment reserves. As a guide, undeveloped risk zones and potential sediment reserves should be kept free from urbanisation and urban sprawl.

Natural and technological risks. Coastal erosion should be clearly identified as a hazard, not least because it is an important factor in marine flooding. As part of the wider initiative on risks and insurance it is recommended that the Commission launches a debate on instruments, which could transfer an appropriate part of the cost of combating coastal erosion in risk areas to the beneficiaries and investors. Key questions in relation to such a debate are described above (see *financial instruments*) This debate may be initiated via a consultation paper to be jointly issued by Directorate General Environment and Directorate General Internal Market to seek views on the role of Insurance and bank sectors to support this transfer of risks. Preliminary discussions with the Insurance Committee established by EU Council Directive of December 19, 1991, and the European Federation of National Insurance Associations (CEA) should make it possible to extend these scope and issues.

Financial instruments, Environmental Assessment and Art. 6 Habitats Directive: As part of the existing assessment of all financial instruments and the implementation of the directives, it is importnat to assess the potential impacts of projects on the coastal sediment balance and risks to safety of people, economic assets or coastal biodiversity. Appropriate mitigation and compensation measures should be considered in this assessment. Projects in the field of infrastructure (Trans-European Networks, short sea shipping) and water management should not be supported if they are likely to cause adverse impacts requiring subsequent mitigation measures. Funding incentives should be considered for the elaboration of risk maps.

Flood Policy: Coastal erosion is to be recognised as an important factor in coastal flooding, and should be subject to flood action plans.

2.2. Elaboration at Member States level

In addressing human impact via SEA and EIA, it is recommended that coastal erosion becomes a **mandatory topic** to be assessed in relation a wide variety of plans and programmes including planning, transport, tourist developments and offshore aggregate extraction, which affect the coast. SEA should be promoted as an important new instrument for Environmental Assessment for coastal erosion management.

The management of expectations in connection with risk is a crucial part of policy application. It must be made clear that development in risk locations will only be allowed where it does not lead to the need for subsequent action to reduce the level of risk from coastal erosion.

In connection with the identification of strategic sediment reservoirs it is important to prepare a mechanism to allow for expropriation or compensation in order to accommodate managed realignment, in compliance with EC competition regulations. An example is provided by the French Law that facilitates expropriation of assets threatened by natural hazards (Loi Barnier).

2.3. Elaboration at the level of coastal regions

Regional authorities should promote public information and awareness of coastal erosion risks, as a basis for coastal planning and management. Consultation with stakeholder groups and the public, to help ensure that coastal management policies are understood should be a priority. Particular attention should be given to Environmental Assessment in relation to socio-economic and financial risks.
The understanding of risks should be promoted through the production and dissemination of risk maps at local scale (1:25,000).
In order to support the implementation of Recommendation nr. 2, EUROSION is producing guidelines on:
- environmental assessment to improve integration of coastal erosion concerns into future investments. These guidelines should be made available to a wide range of Environmental Assessment practitioners and translated into the EU official languages;
- coastal erosion risk mapping for incorporation into land use planning and reporting.

Recommendation nr. 3 Make responses to coastal erosion accountable

Coastal erosion management should move away from piecemeal solutions to a planned approach based upon accountability principles, by optimising investment costs against values at risk, increasing social acceptability of actions and keeping options open for the future. This move should be driven by the need to restore the coastal resilience and meet the conditions of favourable sediment status as developed in previous recommendations. It should be supported by the elaboration and the implementation of Coastal Sediment Management Plans (CSMP)

3.1. Elaboration at EU-level

EU Recommendation on ICZM: the results of EUROSION including the Shoreline Management Guide (providing best practice information on coastal erosion management) should be widely disseminated, e.g. to Member States, coastal networks, and EU funded projects.
Financial instruments (esp. Cohesion policy funding 'Environment and Risk', Rural development funding, and European Investment Bank): As part of the existing conditionality assessments, coastal erosion management projects should not be supported if they could cause adverse impacts requiring subsequent mitigation measures. Funding incentives should be provided to programmes aimed at restoring the sediment balance and coastal resilience.

3.2. Elaboration at Member States level

Responsibilities for elaborating coastal sediment management plans should be devolved to regional authorities whose coastline is entirely or partly included within a coastal sediment cell. When more than one region is concerned interregional arrangements should be established to elaborate shoreline management plans.

Member States should promote the dissemination of best practice information on coastal erosion management (incl. the EUROSION Shoreline Management Guide) in their own language.

3.3. Elaboration at the level of coastal regions:

Regional authorities should undertake responsibility for the development of CSMPs and ensure that shoreline management is made fully compliant with the above principles of accountability.
CSMPs should be established for 5 to 10 years, be subject to a SEA, and periodically evaluated and revised.

Recommendation nr. 4 Strengthen the knowledge base of coastal erosion management and planning

The knowledge base of coastal erosion management and planning should be strengthened through the development of information management strategies. These should include as a

starting point dissemination of 'best practice (what works and what doesn't), provide a proactive approach to data and information management and have institutional leadership at the regional level.

4.1. Elaboration at EU-level

INSPIRE Directive. The future Directive meant to establish an Infrastructure for Spatial Data in Europe (INSPIRE) should support the standardized delineation of coastal sediment cells by incorporating key input datasets required for such a delineation into Spatial Data Infrastructure (SDI) standards being established under the terms of the Directive.

GMES. Future community research activities of the Global Monitoring of Environment and Security (GMES) towards the establishment of Europe-wide standardized methodologies for delineating coastal sediment cells, including methodologies relating to the production or modelling of datasets required for delineating such sediment cells, and towards shoreline economics. As regards methodologies for delineating coastal sediment cells, a particular attention shall be paid to:

- techniques combining very high resolution remote sensing products such as laser altimetry or high frequency doppler sensors, and field surveying devices (e.g. GPS, WESP);
- improvement and integration of existing models used to simulate nearshore wave regime and nearshore currents. Major among these models in Europe are SWAN and UNIBEST (*Delft Hydraulics*), MIKE (*Danish Hydraulics Institute*), and TELEMAC (I).

As far as shoreline economics and in line with recommendation 4, priority should be given to the development of valuation techniques which enable a cartographic representation and GIS processing of social, ecological and economical values along the shoreline .

INTERREG. The European Commission should recognise the elaboration of coastal sediment cell-based Coastal Sediment Management Plans (CSMP) as a priority topic of regional development policies in coastal zones and support exchange of experience among regions and joint elaboration of CSMP accordingly via INTERREG funding.

European Environment Agency. The mandate of the European Environment Agency (EEA) and its Topic Centre on Terrestrial Environment (ETC/TE) should be extended to the periodical updating and assessment of the exposure of European coastal regions to coastal erosion and its reporting to the European Commission, Member States and coastal regions. It is however recommended that the update methodology is fine-tuned taking into account the following limitations and perspectives:

- indicators no. 2 and 3 (shoreline evolution) suffer in some areas from a lack of information of the CORINE Coastal erosion database (covering period 1985-1990). A significant part of the coastline (approximately 30%) does not include any validated information on erosion trends (mainly "presumed" information and to a lesser extent, missing information). In these conditions, it is difficult to discriminate between recently observed erosion trends (eroding sites which were not eroding in 1985-1990) from eroding sites already known in 1985-1990 as being eroding. In these cases, the project considered the presumed information featured in the database as being true (i.e. validated). For areas where such information was missing, the project gave the coastline section the highest score (2 points) by default;
- indicator no. 8 (elevation) can be improved through a better knowledge of coastal elevation – including a GIS representation of the 1-meter-contour line. This could help discriminate areas highly exposed to coastal flooding (below 1 meter) from areas moderately exposed to flooding (between 1 meter and 5 meters);
- Calculation of indicator no. 10 (population within the RICE) is based upon on the methodology developed by the Joint Research Centre of the European Commission (JRC)[6]. This methodology consists in reallocating demographic data – typically known at the level of European municipalities (NUTS5 level) – to land cover units, assuming that population are more likely to live in urban areas than in agricultural lands or forest areas.

6. *Gallego J., Peedell S., Using CORINE Land Cover to map population density, JRC, 2000 (contribution to the publication "Towards agri-environmental indicators", EEA)*

If the methodology is estimated by JRC to give good results for most European regions, less accurate data may be obtained in certain regions (errors may reach 5,000 persons). Development are still ongoing at JRC and EEA;

- Indicator 11 (coastal urbanization rate) is derived from the LACOAST data extended to accessing countries. However quality control procedures have revealed that LACOAST data for Greece suffer from a poor quality which tend to minimize the influence of demographic growth and urban sprawl in Greek coastal areas;
- Attempts have been made to cover the concept of "major" socio-economic assets with indicator no. 12, but it is realised that some important assets will be missed e.g the presence of a (nuclear) power station within the RICE; nor does it preclude that some assets of sub-national importance may require immediate erosion management measures;
- Indicator no. 13 can provide best results if Natura 2000 GIS files could be used. However, due to access restrictions to Natura 2000 data by the Commission and Member States, CORINE Biotopes database has been used as a proxy of areas of high ecological values. The assessment should be fine-tuned as soon as Natura 2000 GIS data become available;
- The rating of European coastal regions according to their exposure to erosion, and mapping them, can in no way be prescriptive in terms of shoreline management policy options. The level of details featured by the Europe-wide database, however, preclude any precise recommendations. They should be seen as instruments to set priorities in terms of setting a timeframe for establishing and re-evaluating shoreline management plans and investments. Further investigations will be needed to confirm and quantify the risks so that decision-makers are provided with the best available information for policy development;
- Finally, the calculation of exposure indicators at the level of European coastal sediment cells instead of coastal regions may be far more relevant. This depends however on the availability in the near future of coastal sediment cell boundaries.

4.2. Elaboration at Member States level

Member States should support the standardized delineation of coastal sediment cells at the level of their respective territory, via the production of key input datasets – namely accurate coastline position, coastal elevation and near-shore bathymetry, hydrography, near-shore wave regime, and tide prediction – and their integration into their national spatial data infrastructure (NSDI). Member States should also liase to the GMES initiative to jointly develop a standardized methodology for mapping the boundaries of European coastal sediment cells, with a particular emphasis on cross-border coastal sediment cells.
Finally, Member States should support interregional cooperation as well as research and development to support the joint elaboration of coastal sediment management plans (CSMP)

4.3. Elaboration at the level of coastal regions

At regional to local scales, production, processing, storage, update, exchange and dissemination of relevant information on coastal erosion processes and coastline management should be considered as key prerequisites to ensure successful shoreline management operations. Regional authorities should play a lead role in creating the adequate institutional and technical conditions for such activities to take place, and their benefits maximised. This should be achieved through the elaboration and implementation by regional authorities of a strategy on "**coastal information governance**". This strategy should not be restricted to coastline management, but extended to the broader context of integrated coastal zone management, wherever such approaches exist. These regional information strategies should build upon the following principles:

- *Principle 1* - a lead authority working in partnership with a wide range of local to national stakeholders;
- *Principle 2* – a commitment to share relevant information (or data);
- *Principle 3* - use a well-documented web-based information system using internationally recognised standards;

- . *Principle 4* - institutions retain responsibility for their own data including quality, timeliness and for its dissemination;

Appendix 5 Overview of EUROSION reports & guides

PART 1 - Major findings and Policy Recommendations of the EUROSION project (4.0 MB) - French version (7.5 MB)

PART 2 - Maps and statistics (1.7 MB)

PART 3 – Methodology for assessing regional indicators (2.3 MB)

PART 4 – A guide to coastal erosion management practices in Europe: Lessons Learned (0.4 MB) - French version (0.4 MB) (also in Shoreline Management Guide)

PART 5_0 – Guidelines for implementing local information systems dedicated to coastal erosion management *Executive Summary* (0.8 MB) - French version (0,7 MB)

PART 5_1 – Organisational and management aspects of coastal information (zip-file 1.3 MB) - French version (zip-file 1.7 MB)

PART 5_2– Guidance document for quick hazard assessment of coastal erosion and associated flooding (2.2 MB) - French version (0.7 MB)

PART 5_3 – Guidelines for incorporating cost benefit analysis into the implementation of shoreline management measures (1.2 MB) - French version (1.2 MB)

PART 5_4 – Guidelines for incorporating coastal erosion issues into Environmental Assessment (EA) procedures (1.8 MB) - French version (1.6 MB)

PART 5_5 – Guidelines for implementing local information systems dedicated to coastal erosion management - Information system functionalities (0.5 MB) - French version (0.5 MB)

PART 5_6 – Data contents specifications (1.9 MB)

PART 5_7 – Guidelines for implementing local information systems dedicated to coastal erosion management - Data architecture modelling and spatial data representation (zip-file 1.8 MB)

PART 5_8a – Manual of procedures for setting up Local Information Systems - VOLUME I : MANAGEMENT PROCEDURES (zip-file 1.4 MB)

PART 5_8b – Manual of procedures for setting up Local Information System - VOLUME II : TECHNICAL SPECIFICATIONS (0.3 MB)

Shoreline Management Guide (SMG) July 2004 (zip-file 4.4 MB)

Quick Start to the EUROSION Database May 2004 (1.7 MB)

EUROSION Dataset Structure September 2003 (appro. 1 MB)

Appendix 6 Eurosion Shoreline Management Guide (SMG)

It aims to provide coastal managers at the European, national and - most of all - regional and municipal levels with a state-of-the-art of coastal erosion management solutions in Europe, based on the review of 60 case studies deemed to be representative of the European coastal diversity. It is however important to mention that this "guide" is not a "manual" of coastal erosion management. The reason for this is threefold:

(i) Such manuals already exist, even though they mostly focus on coastal defence and may therefore suggest that coastal erosion is necessarily a problem to be combated. EUROSION particularly recommends two particular manuals: (i) the *Code of Practice Environmentally Friendly Coastal Protection* (1996) elaborated with the support of the Government of Ireland and the LIFE Programme of the European Commission in the framework of the ECOPRO initiative; and (ii) the *Coastal Engineering Manual* (CEM) published by the United States' Corps of Engineers in 2001.

(ii) Beyond theoretical principles which may be explained in more or less simple terms to non coastal engineers, coastal erosion management is a highly uncertain task as knowledge about coastal processes is still fragmented and empirical. Trying to summarise such sparse knowledge in a new manual would lead to excessive simplification and would tend to minimize the important role of coastal engineers in the design of tailor-made coastal erosion management solutions.

(iii) Finally, the notion of a successful coastal erosion management depends on the objectives assigned to it, which may greatly vary from one site to another according to the local perception of the problem and subsequent expectations. *In that perspective, the reader will probably be astonished to realize that very few of the case studies can be rated as successful.* Drafting another manual would inevitably result in adopting specific point of views – as it is the case for coastal protection manuals – which may not reflect the local expectation and social acceptability of solutions designed.

The approach preferred by the project team was therefore to provide a condensed description of the various case studies reviewed, the physical description of their environment, the known causes of coastal erosion and their current and anticipated impact on social and economical assets, the technical specifications of the solutions proposed as well as their positive and negative results from the perspective of local inhabitants. The review as such does not pass judgement on the success or failure of coastal erosion management solutions implemented. It tries however to highlight which objectives were initially assigned to such solutions and how far such objectives have been reached. *Again, the readers will probably be surprised to see that very few case studies have clearly defined their objectives for coastal erosion management.*

It is assumed that, with such an approach, the coastal manager, specialist or not of coastal engineering, will be in a position to understand the major obstacles he/she may encounter in deciding which coastal erosion management design fits the best his/her area, by tapping into a wide range of European experiences.

The shoreline management guide is composed of the following elements:

- an introduction to the criteria used to select the case studies reviewed during the project and the methodology adopted to collect information on these case studies.
- An extensive summary of the major lessons learned from this review, which also stand for the major elements any coastal manager should keep in mind before undertaking coastal erosion management projects
- An analysis report, organised by regional seas and assessment levels, which is an attempt to compare the various approaches highlighted by the review of the 60 case studies and to find common patterns among them.

- 60 condensed reports related to the cases studies reviewed, organised according to a standard review structure

Appendix 7 Lessons learned from case studies (SMG)

Lesson 1: Erosion types, occurrence and the human driver
Human influence, particularly urbanisation and economic activities, in the coastal zone has turned coastal erosion from a natural phenomenon into a problem of growing intensity. Adverse impacts of coastal erosion most frequently encountered in Europe can be grouped in four categories: (i) coastal flooding as a result of complete dune erosion, (ii) undermining of sea defence associated to foreshore erosion and coastal squeeze, and (iii) retreating cliffs, beaches and dunes causing loss of lands of economical and ecological values.

Lesson 2: Erosion origins, natural and human-induced
Coastal erosion results from a combination of various factors – both natural and human-induced – which has different time and space patterns and have different nature (continuous or incidental, reversible or non-reversible). In addition, uncertainties still remain about the interactions of the forcing agents, as well as on the significance of non-local causes of erosion.

Lesson 3: Environmental Impact Assessment and coastal erosion
Coastal erosion induced by human activities have surpassed in Europe coastal erosion driven by natural factors. Human-induced coastal erosion mainly proceeds from the cumulative and indirect impacts of small and medium size projects, as well as from river damming. However, little attention is being paid to these impacts by project developers, Environmental Impact Assessment (EIA) practitioners and competent authorities.

Lesson 4:Knowledge of erosion processes
Knowledge on the forcing agents of coastal erosion and their complex interaction tends to increase over time. However, this knowledge is fragmented and empirical as reflected by the many different types of models commonly used throughout Europe to anticipate coastal morphological changes.

Lesson 5: Local management action in broader perspective
Past measures to manage coastal erosion have generally been designed from a local perspective: they have ignored the influence of non-local forcing agents and have disregarded the sediment transport processes within the larger coastal system. As a consequence, they have locally aggravated coastal erosion problems, and have triggered new erosion problems in other places. They still influence the design of present measures.

Lesson 6: The coastal sediment cell
As an attempt to better respond locally to non-local causes of coastal erosion and to anticipate the impact of erosion management measures, a number of cases mainly in Northern Europe have built their coastal erosion management strategies upon the concept of "sediment cell" as well as on a better understanding of sediment transport patterns within this sediment cell. Such approaches require a strong cooperation between regions, which share a same sediment cell.

Lesson 7: No miracle solutions, but learning through experience
Experience has shown that, at the present time, there is no miracle solution to counteract the adverse effects of coastal erosion. Best results have been achieved by combining different types of coastal defence including hard and soft solutions, taking advantage of their respective benefits though mitigating their respective drawbacks.

Lesson 8:The setting of clear objectives, towards accountability
Assignment of clear and measurable objectives to coastal erosion management solutions - expressed for example in terms of accepted level of risk, tolerated loss of land, or beach/dune

carrying capacity - optimises their long-term cost-effectiveness and their social acceptability. This has been facilitated by the decrease of costs related to monitoring tools.

Lesson 9: Multi-functional design and acceptability
Multi-functional technical designs, i.e. which fulfils social and economical functions in addition to coastal protection, are more easily accepted by local population and more viable economically.

Lesson 10: Cost - benefit analysis
Though critical for decision-making, the balance of coastal defence costs and their associated benefits is - in general - poorly addressed in Europe. This may lead to expenses, which are at the long run unacceptable for the society compared to the benefits.

Appendix 8 EUROSION Methodology for assessing regional indicators

The main objective of this report is to provide a comprehensive description of the calculation of the EUROSION Indicators (technical and conceptual) which will support the rating of European regions in terms of exposure to coastal erosion.

Identification of a set of reference indicators
The identification of a set of reference indicators aims to provide a meaningful and measurable "snapshot" – as of 2002 – of the major details of coastal erosion processes throughout Europe. This was based upon the DPSIR model (Driving forces - Pressure - State - Impact - Responses) as recommended by the European Environment Agency (EEA). Because of the complexities of the interactions a simplified PSIR approach has been adopted as a basis for policy recommendations for specific stretches of coast, based upon an identification of the most important reference indicators for the Pressures acting on the physics of the coast, for its physical State, for the potential Impact of these pressures (to life, economy and environment) and, finally, for the Responses implemented from a technical point of view. As a preliminary to this process, the project found it convenient to introduce the concept of radius of influence of coastal erosion (RICE).

Radius of influence of coastal erosion
The EUROSION project found it convenient to introduce the concept of radius of influence of coastal erosion (RICE). The exposure of population, infrastructure and ecological valuable areas to the effects of erosion (and or flooding) depends on their direct and surrounding physical location. In order to come to a first assessment of these exposed areas and their related level of risks, the quantity, quality and location has been determined. The RICE concept is meant to provide a proxy of the terrestrial areas, which may potentially be subject to coastal erosion or flooding in the coming period of 100 years. To determine this radius a distinction between the two most important flooding and erosion parameters is made. The definition of RICE and its methodological delimitation are presented in chapter 3 and 4. Once defined the concept of RICE, the approach led to consider 13 indicators in relation with the current and expected future exposure to coastal erosion and flooding (see table BB).

Calculation of indicators at the regional level
The above mentioned list of indicators has been calculated and reported at the regional level. By regional level, the project means, as a general rule, the executive level which operates directly below the national level. With reference to the Nomenclature of Territorial Units (NUTS) defined by Eurostat, this may correspond to NUTS 1 level (e.g. Belgium, Germany, United Kingdom) or NUTS 2 level (e.g. France, Spain, Italy) depending on the country. In some cases, small countries have been considered as a whole (e.g. Denmark, Baltic countries). It is also important to notice that "executive level" does not necessarily mean that a "regional government" exists at that level. This is in particular the case for England where the regional level is a level of representation of the central government in the fields (via government offices) and not a level of devolution as such. A comprehensive list of such European coastal regions is provided in the report.

Rating of European regions in terms of exposure to coastal erosion and flooding
It is assumed that the exposure of European regions to coastal erosion and flooding can derived by combining the above mentioned indicators in such a way that the combination considered a) reflects the current and future pressure factors relating to coastal erosion and flooding b) reflects the potential impact of coastal erosion and flooding to assets located in the coastal areas. This leads to an approach that makes the priority of shoreline management

depending on the extent to which threshold values for all indicators are exceeded or not, using “pressure scoring” and “impact scoring” as illustrated in table BB.
Due to limitations in the data available, it is not possible to include at this point indicators on the responses – e.g. budget invested in coastline management – which help mitigate the potential impact of coastal erosion and flooding, and therefore to finetune the impact scoring.
The report elaborates the methodology for the calculation of the RICE and the indicators.

Table BB *Indicator-based methodology for rating European regions in terms of coastal erosion and flooding*

METHODOLOGY FOR RATING EUROPEAN REGIONS IN TERMS OF COASTAL EROSION AND FLOODING			
Indicator	**0 point**	**1 point**	**2 points**
Pressure scoring			
1) Relative sea level rise (best estimate for the next 100 years)	*< 0 cm (per region)*	*Between 0 and 40cm (per region)*	*> 40 cm (per region)*
2) Shoreline evolution trend status	*Less than 20% of the shoreline is in erosion or in accretion (per region)*	*Between 20% and 60% of the shoreline is in erosion or in accretion (per region)*	*More than 60% of the shoreline is in erosion or in accretion (per region)*
3) Shoreline changes from stability to erosion or accretion between the 2 versions (CCEr and CEL)	*Less than 10% of the shoreline changes between the 2 versions (CCEr and CEL)*	*Between 10 and 30% of the shoreline have changed between the 2 versions (CCEr and CEL)*	*More than 30% of the shoreline have changed between the 2 versions (CCEr and CEL)*
4) Highest water level	*Less than 1,5 meters*	*Between 1,5 and 3 meters*	*More than 3 meters*
5) Coastal urbanization (in the 10 km land strip)	*Urban areas (in km2) have increased of less than 5% between 1975 and present*	*Urban areas (in km2) have increased of 5 to 10% between 1975 and present*	*Urban areas (in km2) have increased of more than 10% between 1975 and present*
6) Reduction of river sediment supply (ratio)	*Ratio between effective volume of river sediment discharged and theoretical volume (i.e. without dams) is superior to 80%*	*Ratio between 50 and 80%*	*Ratio is less than 50%*
7) Geological coastal type	*> 70% of "likely non erodable" segments*[1]	*"likely non erodable segments" between 40% and 70%*	*< 40% of "likely non erodable segments"*
8) Elevation	*< 5% of the region area lies below 5 meters*	*Between 5 and 10% of the region area lies below 5 meters*	*> 10% of the region area lies below 5 meters*
9) Engineered frontage (including protection structure)	*< 5% of engineered frontage along the regional coastline*	*Between 5% and 35% of engineered frontage along the regional coastline*	*> 35% of engineered frontage along the regional coastline*
Impact scoring			
10) Population living within the RICE	*< 5,000 inhabitants per region*	*Between 5,000 and 20,000 inhabitants per region*	*> 20,000 inhabitants per region*
11) Coastal urbanization (in the 10 km land strip)	*Urban areas (in km2) have increased of less than 5% between 1975 and present*	*Urban areas (in km2) have increased of 5 to 10% between 1975 and present*	*Urban areas (in km2) have increased of more than 10% between 1975 and present*
12) Urban and industrial living within the RICE	*< 10% of the land cover within the RICE is occupied by urban and industrial areas (per region)*	*Between 10% and 40% of the land cover within the RICE is occupied by urban and industrial areas (per region)*	*> 40% of the land cover within the RICE is occupied by urban and industrial areas (per region)*
13) Areas of high ecological value within the RICE	*< 5 % of areas of high ecological value within the RICE per region*	*Between 5% and 30% of areas of high ecological value within the RICE per region*	*> 30% of areas of high ecological value within the RICE per region*

[1] "likely non erodable" segments are defined in the Technical Document – Methodology for the Assessment of EUROSION Indicators "Chapter 4.7 – Geological Coastal Line"