26.- Coastal erosion and accretion

Key message

- All the coastal EU Member States have problems with coastal erosion. Over 20% of the evaluated European coastline is affected. These problems could increase in view of the effects of climate change.
- Defence of the coastline is a very ancient procedure to mitigate coastal erosion. The location of the defences reflects where the most significant problems are and exposes their economic dimension.
- Proper knowledge of the impact of past and present erosion, achieved *inter alia* by means of careful monitoring, will allow better and more sustainable management and protection of the coastline.

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Why monitor coastal erosion and accretion?

The coastal erosion and accretion indicator measures changes in shoreline dynamics and efforts to directly counteract the adverse effects of those dynamics. Detailed **monitoring** of these changes is very important, especially if we take into account that the effects of climate change could increase substantially in the next 100 years. Information on shoreline changes can help to predict future changes and to prepare and develop **adaptation policies** for **climate change** effects.

Coastal erosion and related flood and landslide phenomena normally generate very high economic, social and environmental costs. In order to prevent and to avoid these costs it is necessary to have very good and detailed information about the real impacts in the past and in the present.

This indicator belongs to the set of 3 indicators that monitor progress towards achieving the goals for coastal sustainability set out in the EU Recommendation concerning the implementation of ICZM - *"To recognise the threat to coastal zones posed by climate change and to ensure appropriate and ecologically responsible coastal protection"*.

The indicator has 3 measurements: The length of protected and defended coastline, the length of dynamic coastline and the area and volume of sand nourishment. This IFS includes the results of the 3 measurements.

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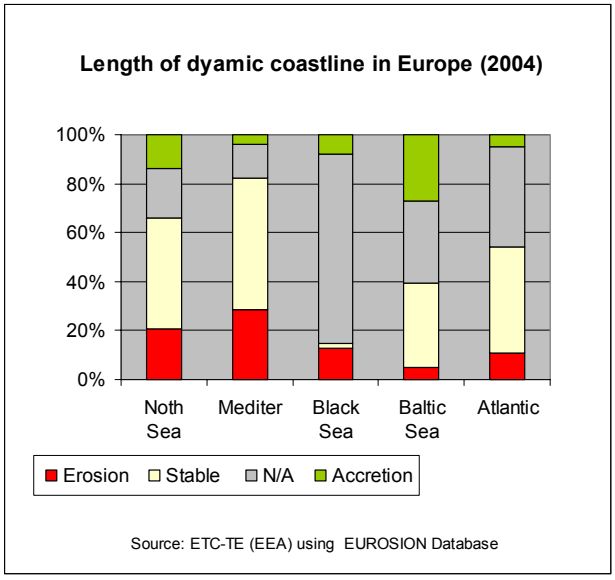
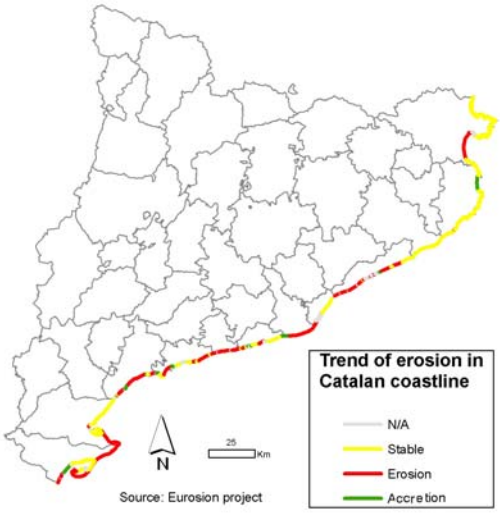
What does the indicator show from European to local level?

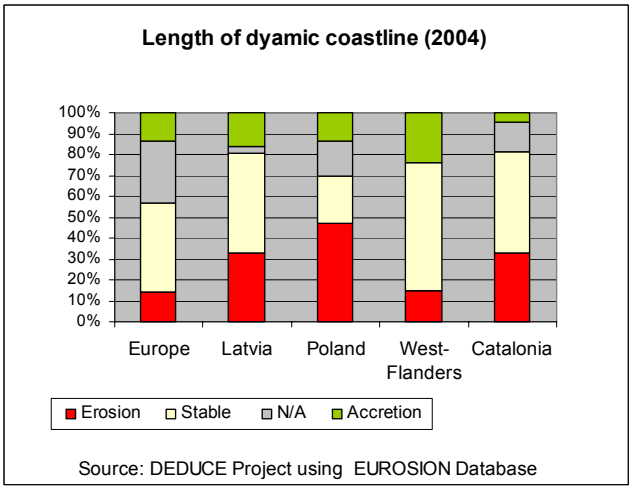
Coastal erosion depends on natural conditions and human actions. The most significant natural conditions are the marine climate (mainly storms - indicator 25), the geology and morphology of the littoral and, recently, climate change (sea level rise and increased storminess). The most significant human influences include the regulation of the river sediment flux in the hinterland and intervention on the coast: harbours, coastal defences, sand nourishment and urban and infrastructure development in the coastal zone.

The EUROSION project has classified 70% of the European coastline according to the sedimentary processes. Some 20% of the European coastline is affected by erosion and along 13%, accumulation processes prevail. Along the European coastline, the highest percentage of coast length is on the Mediterranean and the Black Sea. The Baltic Sea is the only European Sea where the proportion of accumulative coasts is larger than that of eroding coasts.



The quality of the EUROSION database allows for the observation of problems of coastal erosion not only at national but also at regional scale. The map of erosion trends on the Catalan coastline shows, as an illustrative example, territorial differences that cannot be observed on the European map.

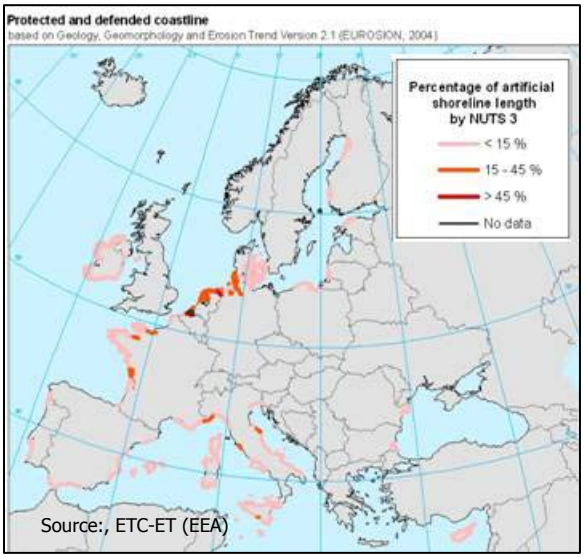


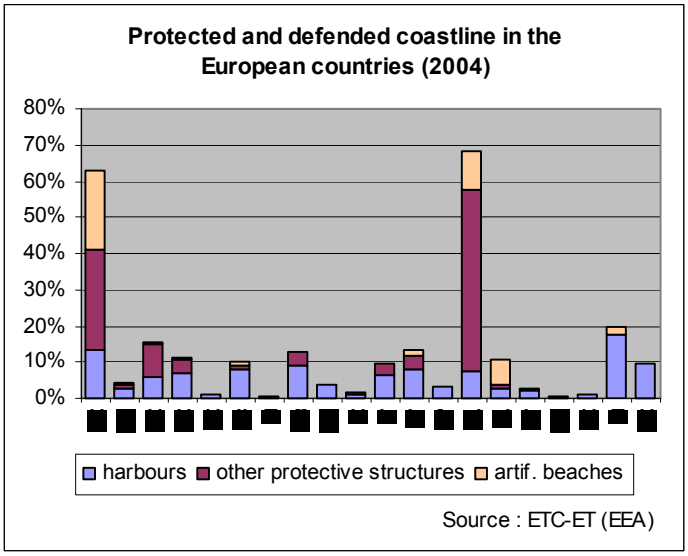


Coastal erosion assessed by the DEDUCE partners in their coverage is higher than the European average except on the West-Flanders coast. It must be highlighted that, despite the fact that the Baltic Sea has the least coastal erosion in Europe, almost all of the problem areas are located along the Polish and Latvian coast. Over 47% of the Polish coastline and 33% of the Latvian coastline is subject to substantial erosion.

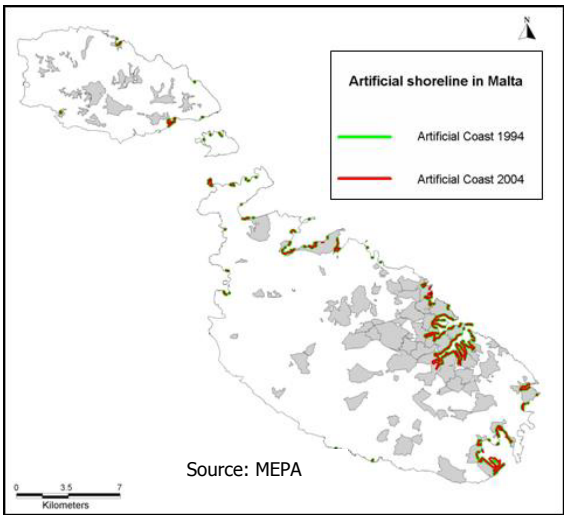
Results and assessment

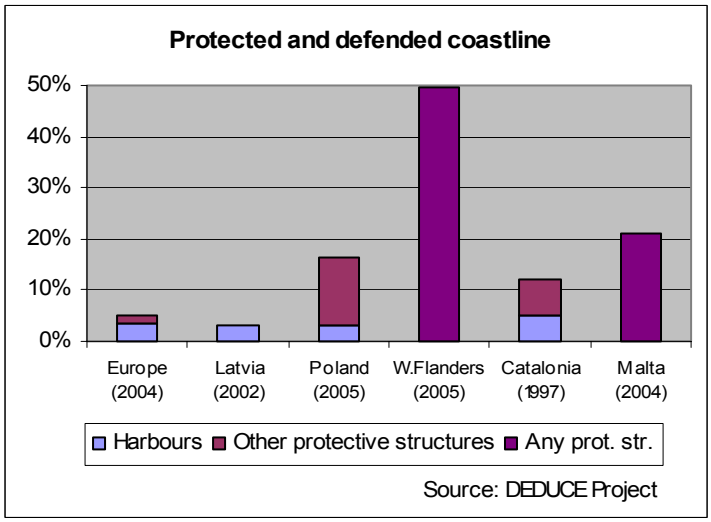
A significant part of the European coastline is artificial: 3.4% is covered by harbours and other protective structures cover 1.8%. Therefore, more than 5% of the European coastline is protected and defended against erosion by so-called "hard" structures.





The level of protection differs a lot between coasts and countries. According to EUROSION, artificial shorelines prevail over the natural ones in 21 European regions (NUTS3). The main areas with an artificial coastline are located in the North Sea: Belgium and The Netherlands show the highest level of defended and protected coast in Europe. This is explained by the fact that extensive areas of these countries have been retrieved from the sea and by the high importance and large dimensions of ports.





Apart from West-Flanders, with nearly 50% of artificial coastline, the percentage of protected coastline of DEDUCE partners is much higher than the European average. The exception is Latvia, where only 3.1% of the coast is protected and the length of protected coast has not increased in the last 20 – 25 years. This only concerns port areas as the rest of the coastline is not defended at all.

The level of coastal artificialisation in Malta is really high: 20.9% (20.4%, ten years previously). It is mostly related to harbour, recreation or road development infrastructure. There are no specific devices for erosion protection.

France (data are shown in the graph of European countries) has a high presence of artificial/protected coast: 9% of harbours and 3.7% of coastal defence structures. Harbours take up more of the North Sea coast while coastal defence structures dominate the Mediterranean coast.

Lengths of coastline protected against erosion by hard structures in Poland and Catalonia are 13.1% and 7.1% respectively. They are larger than the length of coast taken up by harbour protection, at 3.1% and 5.1% respectively.

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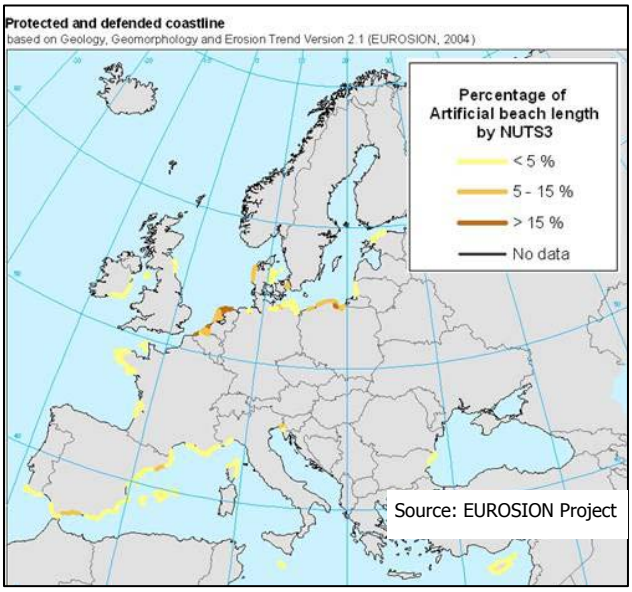
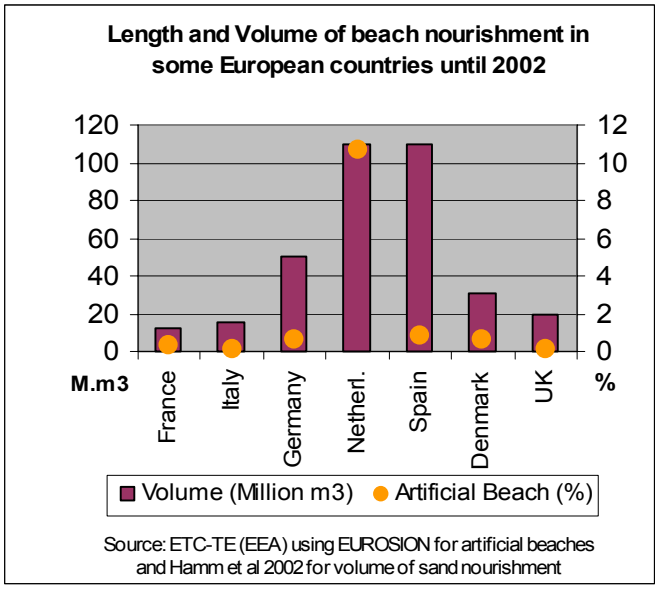
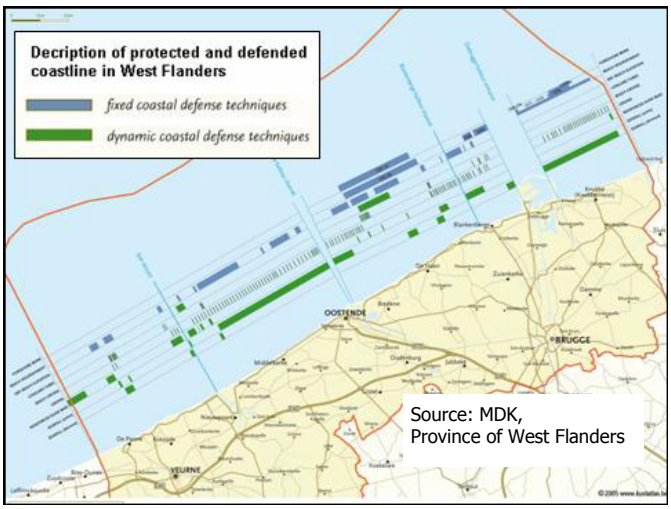
Results and assessment

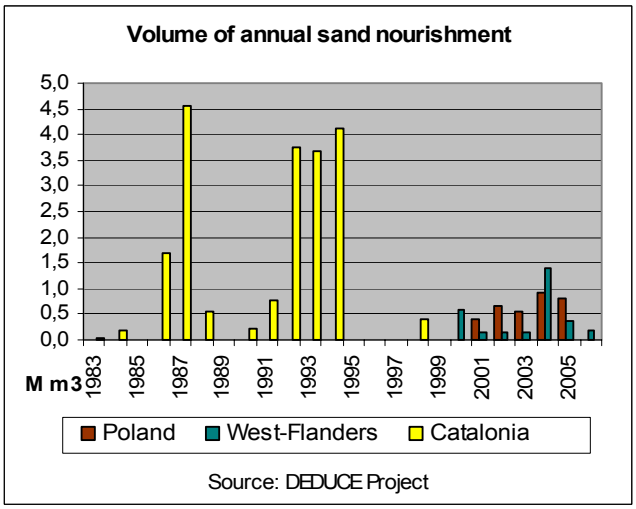
Another way of responding to coastal erosion is with sand nourishment of beaches and foreshore. This "soft-engineering" technique has become the preferred method for coastal protection in European countries. Nourishment is especially important on the coast of Belgium (22.1% of coastline are nourished beaches according to EUROSION), in The Netherlands (10.7%), and Poland (7.1%). In other countries, such as Spain or France, sand nourishment is also applied but its incidence is more local.





In contrast to the previously shown measurements, data on length and volume of sand nourishment are very difficult to compile as there is a lack of monitoring data. The results are therefore not as reliable as the previous ones.





Annual values collected by DEDUCE partners reveal that the annual fluctuations are very large. There are two reasons for this: the first is that to some extent and in some regions exclusively (Catalonia), the volume of nourishment corresponds to the variable effect of coastal storms; the second is that nourishment operations depend on a political decision to spend public money on an action which, to some authorities, seems to result in relatively short term effects. The graph reflects that the administration has questioned the feasibility of the efforts in Catalonia since 1998. In opposition to this situation, in Poland and West-Flanders nourishment is the preferred method of coastal protection and is seen as feasible only if carried out in a systematic and pre-planned way.

Policy and management for a sustainable coast

What are the implications for planning and managing the coastal zone?

One possible attitude towards coastal dynamics is no action - allowing the erosion or accretion to proceed uninterrupted, without any human intervention. However, taking into account the trend of population growth in the coastal zone and the related social and economical value of the potentially affected goods (human structures such as buildings or rail and road networks, beaches and crops or in some cases valuable land-based nature), it is necessary to fight coastal erosion. Coastal protection has become a highly important topic. In a few situations, the practice is to move endangered objects.

Coastal erosion can be counteracted by direct responses that combat the effects of erosion and/or by acting on the origin: the sediment flux. Although temporary responses can be absolutely necessary, good sediment management is needed. Planning and managing of the coastal zone must consider the effect of human intervention on coastal erosion but must also take into account the natural erosion/accretion trends. The indicator on erosion is very important because it can help to measure the impact of many coastal policies.

The importance of coastal tourism in a country implies an interest in the maintenance of beaches. The easiest, fastest and most environment-friendly intervention is nourishment. However it has to be repeated at intervals dependent on location and the intensity of sediment transport. The nourishment data confirms that it has become an important method of mitigating coastal erosion.

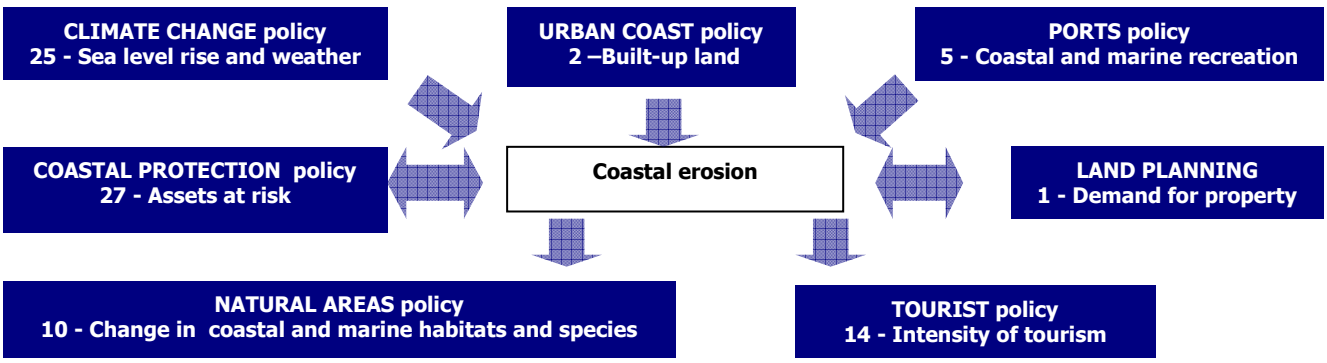
The construction of hard coastal defence structures can be necessary but they are expensive, often resulting in undesirable effects directly in front of structures and along large stretches of neighbouring coastline. Together with harbours, this results in a highly artificial coastline, which is not a desirable situation. There is an inherent conflict between hard coastal defence and the conservation of nature.

Ports disturb the natural patterns of sediment flow, which have shaped the present shorelines. Port structures generate new accretion and erosion processes because breakwaters are a barrier to sediment transport and can force the flow of sediments further offshore. The planning of ports and their location, must therefore also take account of their influence on sediment dynamics and include preventive measures and mitigation solutions.

Results reveal that in some areas, such as West Flanders, there is a coastal protection policy to act generally along the whole coastline. In other areas, such as Latvia, there is practically no intervention but, in the light of predicted climate change scenarios, a new coastal protection policy had to be developed. That policy has been revised in the form of a proactive policy.

Accretion also may create problems, as when inlets fill in, interfering with navigation.

Related policies and indicators:



Further work needed

Solve the lack of data, mainly about sand nourishment and improve reliability; there are discrepancies between regional sources and the EUROSION database.

Periodically update the database on coastal erosion for calculating temporal series. It would allow defining the evolution of processes and the value of the trend in coastal dynamics and, also, the effectiveness of coastal intervention. A measurement showing the rate of coastline retreat/aggradation is needed for effective and sustainable management, so it must be developed and added to the indicator. In addition, improve the database resolution.

Improve the accession to erosion cartography, among other measures by means of selection of coverage.

Feature coastline dynamics in quantitative terms (e.g. Kg of sand / year and meter). The existent data do not reveal the different levels of intensity.

Obtain specific transformation of raw data on artificialisation into protected and defended coastline.

Further information

Data sources

Department of Environment and Housing of Catalan Government:

- Defended and protected coastline: The results are obtained by the combining of data from different sources: the main raw data come from the classification of the coast made by the Investigation Agency "Centre d'Estudis Avançats de Blanes-CSIC" using cartography 1/5000 from 1997. The length of harbour structures was obtained from the "Inventory of harbour installations" (PTOP) and, for 3 of them, by measurement of aerial photographs of the Catalan coast.

- Erosion along coast: EUROSION

- Sand nourishment: The origin of data is the Spanish Ministry of Environment but the data consulted for calculation was obtained from a graduation study of Geology by Maria Navarro Alonso in January 1994.

European Topic Centre Terrestrial Environment (ETC-TE), from the European Environment Agency: EUROSION Database (DG Env.) for all measurements.

Malta Environment and Planning Authority (MEPA): Own digitisation of coastline.

Province of West Flanders: Agenschap Maritieme Dienstverlening en Kust (MDK) – Afdeling Kust

University of Latvia: 1. Raster satellite map (1:50 000) from State land services 2. Set of Charts of Latvia for Yachts (1:2000 - 1:15 000), from Maritime Administration of Latvia, Hydrographic service, 2003.

Maritime Institute Gdansk: Own database of coastal defence structures, reports of maritime offices on nourishment carried out.

Reliability of the indicator

Parameters obtained may be considered as an approximation of the intensity, location and evolution of the erosion problem and the measures that have been implemented. The most reliable measure of this indicator is the length of dynamic coastline and the least reliable is the sand nourishment because the annual series are incomplete or some are not accessible.

It is extremely difficult to find a common parameter and methodology for measurement. DEDUCE proposes a uniform methodology but some calculations, such as the extent of defended and protected coastline, were performed using raw data collected for other requirements and methodologies. For instance, 'stable, erosion and accretion' is defined in different ways by different standards in different countries in the southern North Sea. There are even different definitions of the coastline (all of them 'official') depending on the purpose of the measurement. Depending on the scale of the map, the method of calculating the length of the coast and on categorisation, the result can be quite different.

In contrast, an important strength of the indicator is that most of the data for the measurements come from the EUROSION database of the DG Environment of the European Commission. The results therefore emanate from an official specific study and a common database. Another positive feature is that the database is geographically referenced. Unfortunately, there is no data for around 25% of the European coastline (there are significant gaps in some countries) and the scale of EUROSION allows for regional but not local analysis.

The measurement of dynamic coastline is the only feature of this indicator that is directly obtained from EUROSION. It allows for easy comparison of this parameter between countries.

Digital maps and resolution of aerial photos allow for detailed mapping, especially of artificial coasts. Using EUROSION and other databases, several parameters come from GIS calculation. This fact provides a good level of quality in results but, as has been shown, there are several other factors which reduce the reliability of results.

References

EUROSION project. 2005. **Living with coastal erosion in Europe: Sediment and Space for Sustainability,** European Communities.

SÁNCHEZ-ARCILLA A. ,JIMÉNEZ JA & SIERRA JP (2005)**. B11-Zones costaneres – (Chapter of Informe sobre el Canvi Climàtic a Catalunya)**, Consell Assessor per al Desenvolupament Sostenible de la Generalitat de Catalunya

MINISTERIO DE MEDIO AMBIENTE. **Impactos en la costa española por efecto del cambio climático.** (Part of Fase III. Estrategias frente al cambio climático en la costa).

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