

## 10. PROPOSED THEMATIC LINES - Coastal Zone...

### 10.1. Identification of Thematic Line

#### 10.1.1. Reference of Thematic Lines

TL-4084-1664

#### 10.1.2. Name of the Thematic Lines in Portuguese

Dinâmicas e fragilidades da zona costeira

#### 10.1.3. Name of the Thematic Lines in english

Coastal zone dynamics and fragilities

#### 10.1.4. Principal Investigator

Maria da Assunção Ferreira Pedrosa de Araújo

#### 10.1.5. Scientific areas

Natural and Environmental Sciences - Marine Sciences and Technologies	
Natural and Environmental Sciences - Geosciences	
Natural and Environmental Sciences - Environmental Sciences	
Social Sciences and Humanities - Geography	

### 10.2. Description of the Thematic Lines

#### 10.2.1. Description of the Thematic Lines

The interface land-sea offers many advantages to human life and development, but implies some risks that are more or less severe according to physical geography conditions and human occupation intensity.

In Portuguese coastal zone, a littoralisation process as a consequence of communication facilities, anchored on harbors and main cities, has been in progress since several decades.

The touristic occupation (second residence, summer holidays) increases this trend, creating a pressure on natural resources and conditions.

Too many times, the buildings are erected in risk areas, profiting of every meter available on littoral roads.

We intend to develop a comprehensive analysis of Northern-Central Portugal coastal zone. Our research will be focused mostly in physical geography conditions (geomorphology, climate, sea level changes and coastal dynamics) and in the consequences of these conditions on human occupation, natural hazards, facilities and economic activities.

As a research Centre anchored on Northern Central Portugal we intend to study the coastal zone area from Caminha (Minho River mouth) till S. Pedro de Moel. This area occupies 2 POOCS (Coastal zone management plans). The first one goes from Caminha till Espinho where there is a crystalline basement. Marine sands and sand dunes generally appear upon these crystalline rocks, but they can be eroded by storms and by coastal retreat and crystalline bedrock is outcropping quite often. This old rocky basement constitutes a resource to improve coastal resistance to erosion. At the south of Espinho we have generally soft quaternary formations underlying actual sand and beach dunes. This implies a minor resistance to beach erosion and this area has an important coastal retreat.

Espinho, in the borderland between these two POOCS areas has a long story of sea invasions and a coastal retreat of more than 250 meters between 1875 e 1912. Then, during the XX century the coast was fixed, till ca 1980 when the actual coastal defenses were built. These defenses, added to the lack of sand, have as a result a generalization of the retreat to the south of this city. From summer 2003 till summer 2012, the coastline retreat in S. Pedro de Maceda beach was, in average, 5 meters per year (Google Earth data).

The coastline is a very dynamic environment. This happens not only in natural sense but also in socio-economic sense.

Some of the reasons are enumerated:

1 – Geology: when we have hard rock basement, erosion is not so easy. However, even in this situation there are some spots (estuaries, lagoons, thick dunes) where the bedrock may be quite deep. In this situation erosion can be very fast and can destroy very valuable environments. To the south of Espinho this is the current situation. Possibly there is a tectonic trend implying some subsidence in this sedimentary basin (Lusitanian Ceno-Mesozoic basin).

2 – A sedimentary deficit because of dam construction. All the main rivers at the North of Espinho have been dammed for electricity production. The sediments that don't arrive to

the coastline because of this create a serious deficit on the beaches. About 85% of the sediments that these rivers carried in a natural environment were lost because of these dam process.

Beach erosion is a current problem. However, when beach erosion begins, the tendency of the local people is to ask for protective constructions from the authorities. And the result is that coastal defenses generally aggravate the problem and they export it to the south (the general sense of littoral drift in western Portugal).

3 – We have one of the most energetic coastlines in the world. In Leixões buoy (near Porto) we have registrations of more than 15 meters waves. Northwestern winds are prevalent. So, littoral drift is mainly from north to south. When there are coastal anthropic defenses their northern part is filled with beach sands. However, erosion always attacks the southern sides.

Nevertheless, as Southwestern swell happens and when it is strong and persistent enough, a southern drift is originated and thus apparently protected beaches can be destroyed.

4 - Sea level changes are generally viewed as very important by public opinion. They are always relative. As earth movements are normally slow, climate changes are one of the faster inputs on this equation. A warmer climate will reduce continental ice and a thermal expansion creating a sea level rise.

As a consequence, climate warming after the end of little ice age (ca 1830) created an erosional stress over most of the Portuguese coastlines. It was just during these times that beach erosion began in Espinho and defenses began to be built. From the beginning of XX century the situation was recurrent and heavy defenses (more than 300 meters) have been built at Espinho city in the eighties. After that, the problem was exported to the south and a lot of coastal villages were endangered by coastal erosion. Protections that have been built to protect these villages had the same result as always: they exported the problem to the south.

5 – Littoral climate is quite hazardous. Coastal wind can be very strong. The salinity of the air endangers and spoils man constructions. So, the amenities of the littoral area are not so great as assumed. That's why we have mostly a summer occupation in Northern–Centre coastline but not a permanent one. This creates a big waste on money and resources. Everyone wanted to have a house by the sea... a kind of a housing bubble has been created with high prices for the secondary homes. Much of them are for sale right now.

6 – Coastal tourism is one of the most important economic resources in Portugal. This is mostly true at Algarve but is still important everywhere. However beach erosion and the

ugliness of beach protection are not good assets to a sustainable tourism and the fruition and economic exploitation of the coastline.

7 – The need for a correct management has been emphasized since two decades when the POOCS were created. This meant a serious restriction on littoral building and a good improvement of beach conditions, its cleanness and management. Some natural protected areas were implemented:

- Northern Portuguese littoral (near Esposende, Cávado River mouth),
- Vila do Conde littoral (south of Ave River),
- S. Jacinto dunes (Aveiro latitude),
- Mondego Cape (North of Mondego mouth)

This implementation proves the existence of a political will to protect the littoral and to ensure landscape and natural values preservation for future study and fruition.

8 – The understanding of coastal fragility and vulnerability is a valuable strategy for avoiding inadequate uses for the coastline. A general awareness for the concerned population of these specific littoral conditions points out to a need for environmental education and the diffusion of scientific information on littoral dynamics and natural and cultural resources based on land-sea interface.

### **10.3. Research groups involved in the thematic lines**

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RG-4084-2754	Cities, Competitiveness and Wellbeing	
RG-4084-4969	Nature and Environmental Dynamics	
RG-4084-4970	Cultural landscapes, tourism and development	

## **10.4. Structure and Objectives of the Thematic Line 2015-2020**

### **10.4.1. Structure of the Thematic Line**

The organizational structure of this thematic line is based on the following points:

- The fellowship, master and doctoral students will integrate their research in this line of investigation. Post - doc researchers will also be encouraged to be integrated in the objectives of the line.

Previous contacts with national and international researchers who have integrated Ancorim Project (Atlantic Network for Coastal Risk Management), composed of Irish, French, Spanish and Portuguese will be encouraged and developed in order to reinforce the network for coastal research.

- Professor Emeritus Nils Axel Mörner (Stockholm) will be invited to advise researchers on sea level changes and climate changes

- Professor Augusto Perez Alberti (Santiago de Compostela University) will be invited to ensure a comparison on coastal processes in the northern area of the Iberian Peninsula.

- Previous contacts with Earth Science Professors of Coimbra, Aveiro and Lisbon Universities, working on coastal zone will be reinforced.

- Previous contacts with Professor Veloso-Gomes (hydraulic engineering from Porto University) will be very important in order to improve our knowledge on coastal dynamics and to facilitate a collaborative research.

### **10.4.2. Objectives of the Thematic Line**

The objectives are aggregated by coherent sets according to their purpose:

1- Geomorphology: this project will represent an opportunity to compare different stretches of the coastline. Our knowledge on Ave-Espinho littoral platform will be used for comparison with other areas to understand the differences on quaternary deposits development. These differences may be due to different tectonic trends interfering with quaternary sea level changes.

2 – Coastal Dynamics and protection: the area from Caminha till S. Pedro de Moel includes the faster erosional stretches on Portuguese coastline. We intend to monitorize these areas with a differential GPS to understand these dynamics, associating wind and wave situation, beach dynamics and tides.

The dunes are the best natural protection to the coastline. The successful experiences of palisades could be used for its implementation where they are necessary.

South of Espinho there is a large extent of inland dunes. Dunes will be analyzed in the perspective of their classification, dynamics, vegetation, preservation and stabilization.

3 - Coastal climate has peculiar characteristics due to the proximity to the ocean. We will focus on the wind (direction, speed and the special case of the breeze and " front breeze"), temperature and rainfall, fog and salt spray like a secondary effect. All these effects have an important influence on natural vegetation and agricultural/forestry capacity of these areas.

4 - Our knowledge of physical conditions is an asset to coastal human activities and also an opportunity to develop the relationship between different specialties inside CEGOT framework.

We enumerate some of them underlining the relationship between natural resources and sociologic interest:

Artisanal fishing (many small harbors with a rich fishing tradition).

- Offshore fishing (Matosinhos and Aveiro harbors).
- Tourism and recreation (sun and beach, camping, walking, bird watching).
- Salt production (Aveiro), an old and important activity somehow replaced by aquaculture,
- Aquaculture, the algae exploitation (food, pharmacology, fertilizer),
- Sports (surfing, windsurfing, sailing). Portugal has become a destiny for surfing. Climate/dynamic coastal conditions are a key to the development of these activities.
- Sediment exploitation (sand and gravel) for the construction, sediments dredged from harbors.

5 - The proximity or contact with an energetic environment involves exposure to various levels of risk.

The knowledge and awareness of those risks by the population potentially affected by them are fundamental to carry out a rational management of the coastal strip pursuing its sustainability.

Thus, the risk analysis will be developed in two perspectives:

- Understanding the type, spatial distribution, frequency, amplitude, susceptibility and vulnerability to potential natural phenomena such as marine overwash, storm surges, tsunamis and invasion of aeolian sand.

- To improve the perception of risk - focusing on inhabitants of coastal villages (fishermen and others) and even sporadic visitants.

6 - Cooperation with national, regional and municipal institutions to improve scientific knowledge for a better management of the territory. This cooperation is being already developed (environmental education and information, e.g. Live Science Centers, geology in the summer).

The embellishment of coastal areas after POOC implementation must focus on the information offered to the public. CEGOT cooperation with the concerned authorities seems indispensable to ensure correct information on geographical points of interest presents on the coastline.

7 - The topics referred above will be included in the advanced training of masters and doctoral thesis. Scientific meetings, scientific publications, training activities and divulgation papers edited by concerned municipalities will make the dissemination of information and research results.