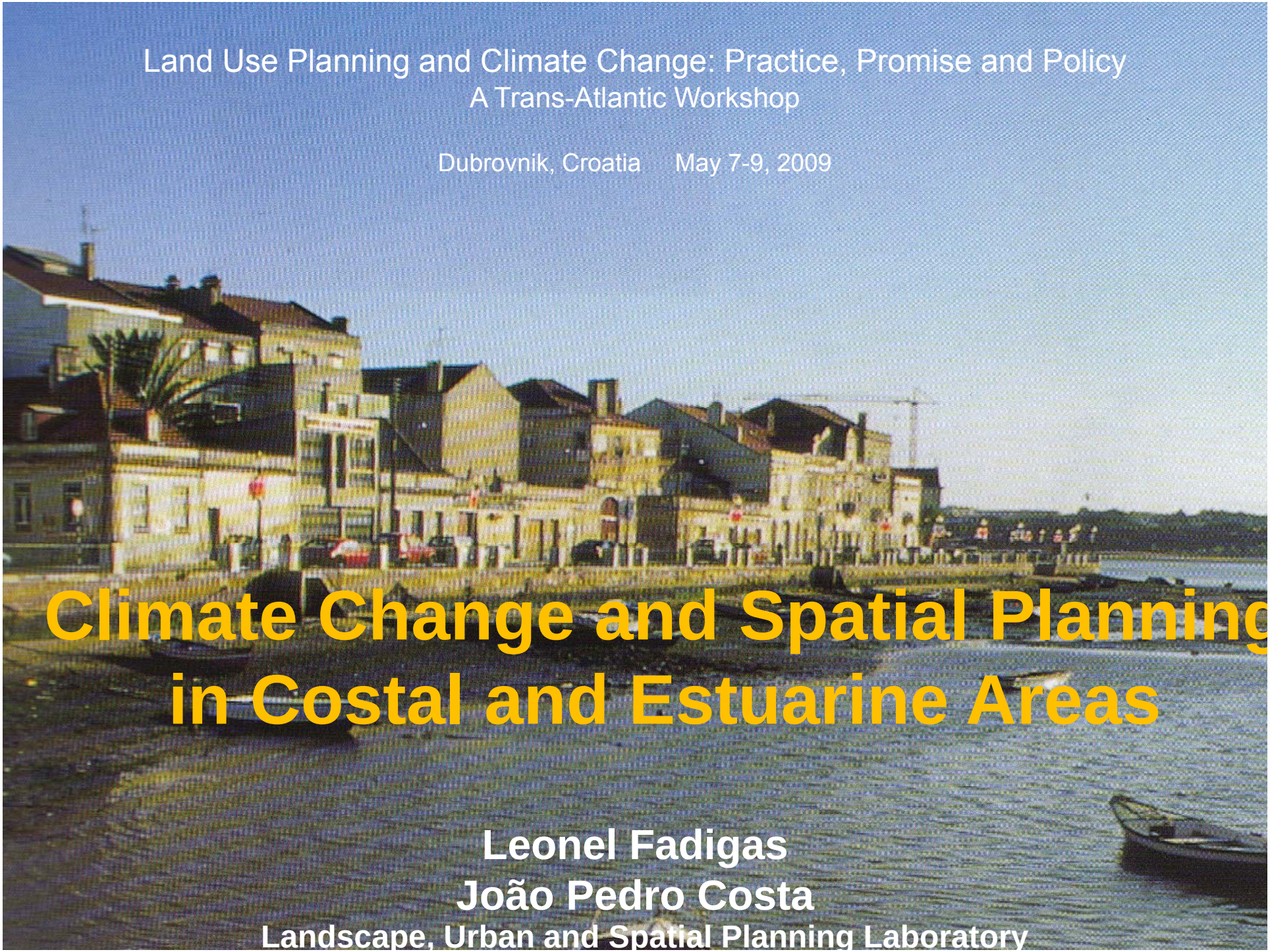

Land Use Planning and Climate Change: Practice, Promise and Policy
A Trans-Atlantic Workshop

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Climate Change and Spatial Planning in Costal and Estuarine Areas

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Climate Changes Portugal overview

- According to projections until 2100, obtained from SIAM (Scenarios, Impacts and Adaptation Measures) project, significant temperature alterations are expected with a large range of regional variations.
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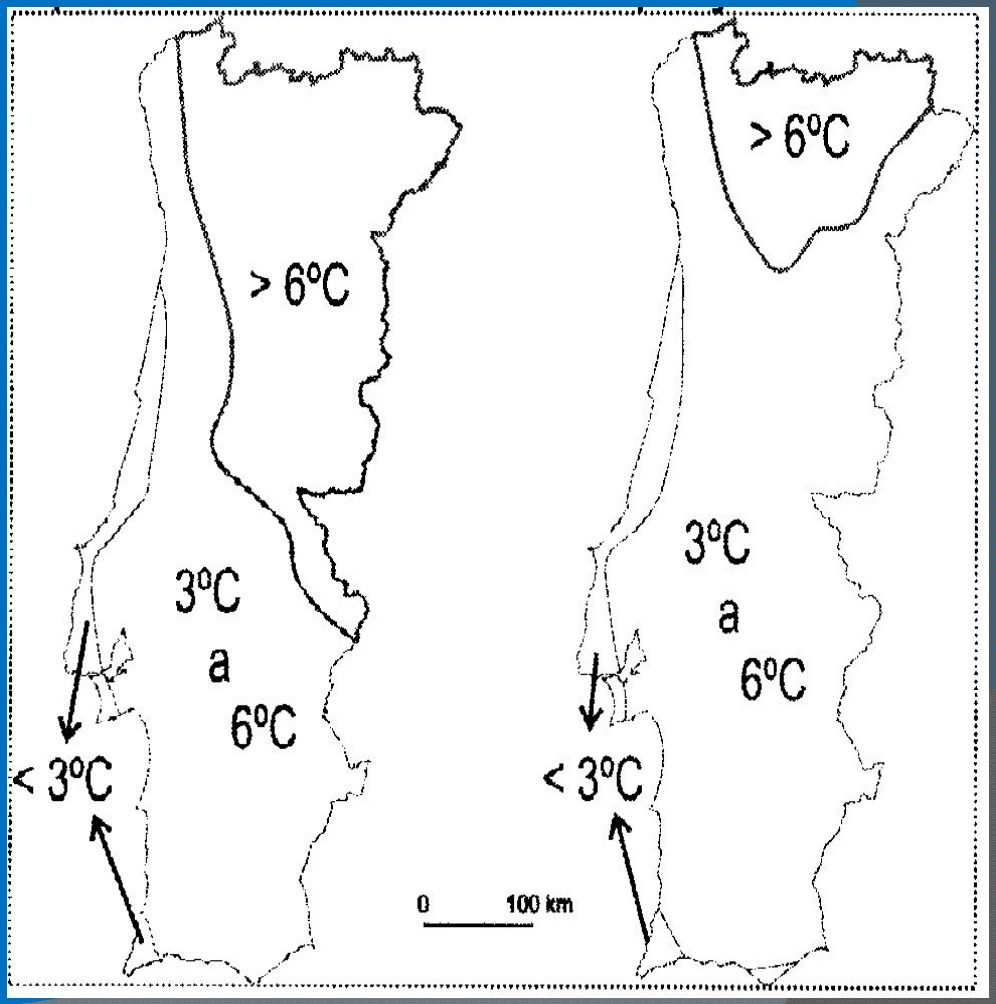
Climate Changes Portugal overview

- A general warming will happen in all the Portuguese continental territory and a significant increase of days with temperature above 35° C.
- In an adverse scenario, in interior regions about 100 days with temperature above 35° C may occur.



Adapted from M.J. Alcoforado *et al*. "***Estudos sobre Cidades e Alterações Climáticas***", C.E.G. ,Lisbon University, 2008

Climate Changes Portugal overview

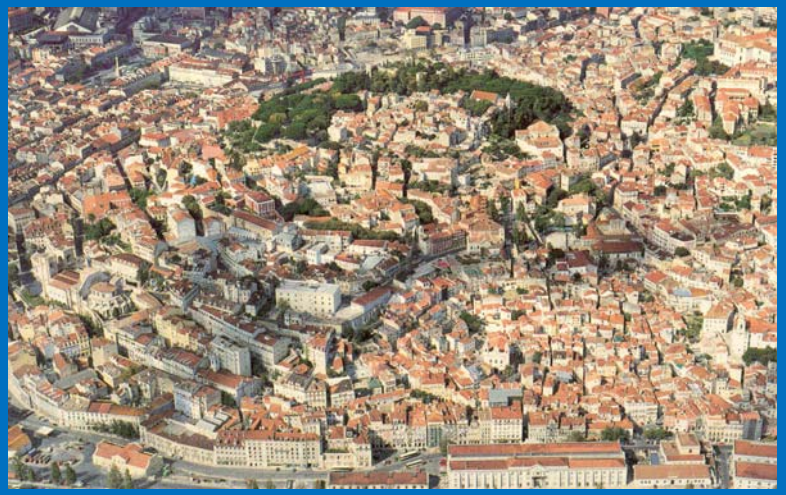
- In winter the number of cold days will be reduced .
- Rainfall may decrease significantly in central and southern regions and increase in northern regions.
- Rainfall season will be reduced.
- Torrential rainfalls will be more frequent.

Global heating impact in urban areas

- Increase of temperature levels may not affect Urban Heat Island but its spatial dimension may be enlarged with urban areas expansion.
- Urban areas expansion will increase energy consumption and will have direct and indirect impact in air pollution and in climatic changes.

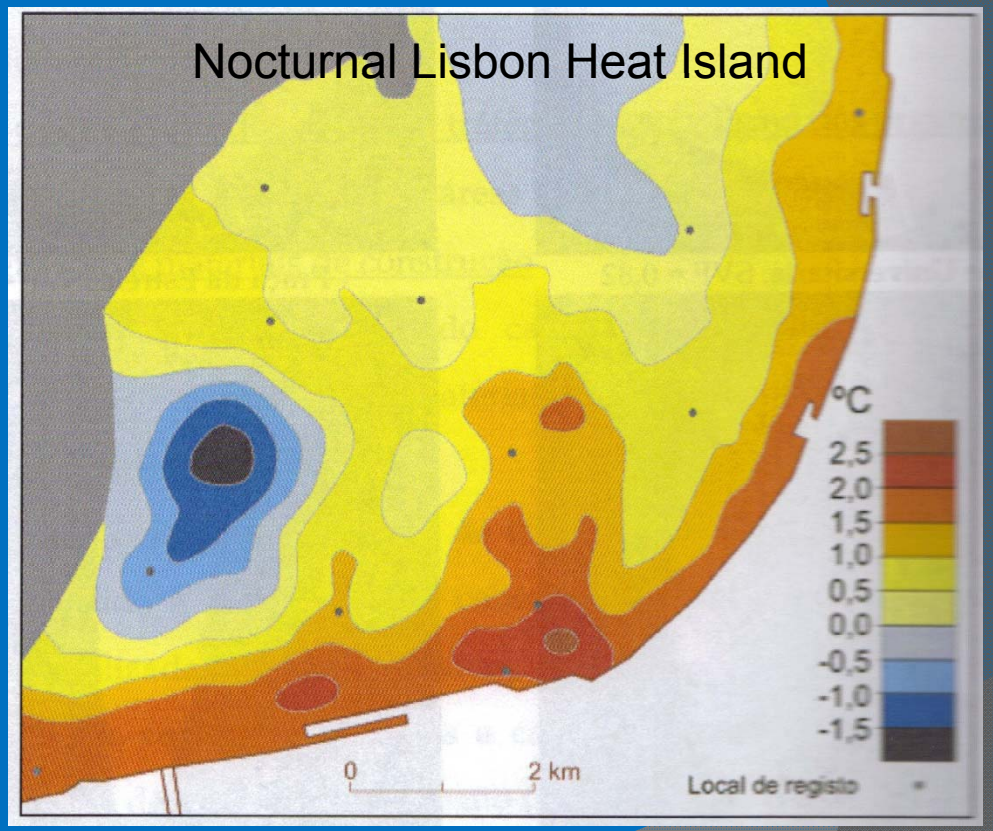
Global heating impact in urban areas

- In urban areas the combination of specific climatic aspects, urban heat island characteristics, topography, urban morphology and dimension may originate serious impacts



Global heating impact in urban areas

- Urban areas are very vulnerable due to high demographic concentration, infrastructures and large impermeable surfaces.
- Impacts intensity depends on the changes speed: less if gradual, bigger if fast.



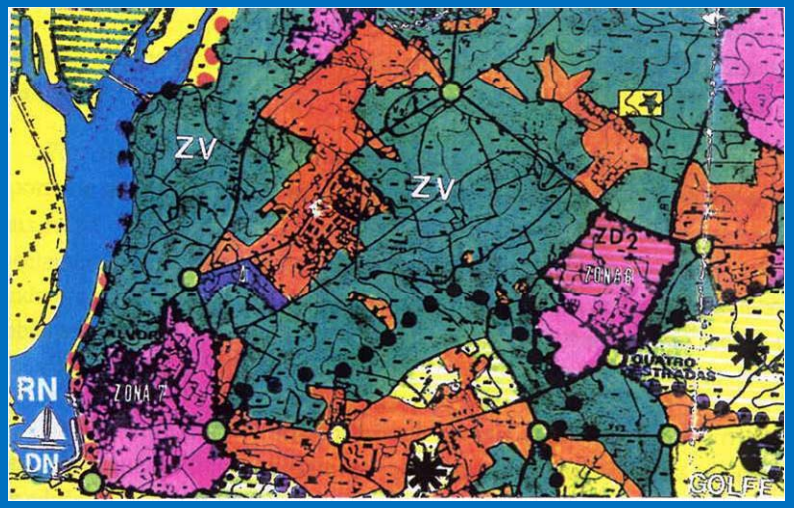
Andrade, H. *Bioclima humano e temperatura do ar em Lisboa* .PhD Thesis, Lisbon University (2003)

Global heating impact in urban areas

- Gradual changes (heating, sea level rise, vegetation acclimatization) allows a gradual adaptation of natural and human systems to the new conditions.
- Fast changes may increase frequency and intensity of weather phenomena and environmental risks and catastrophes.

Global heating impact in urban areas

- Land use and urban planning must be used to prevent territorial and environmental degradation and to keep sustainable conditions of human use of soil and natural, economic, social and built resources.



Global heating impacts on land use

- Negative effects on infrastructures and buildings conservation and durability;
- Negative effects on human health (introduction of new and tropical diseases);
- Negative effects on fauna, vegetation distribution, ecosystems and on agricultural activities;
- Increase of sea level rise and of flood risk in costal and estuarine areas.

Global heating impact on land use

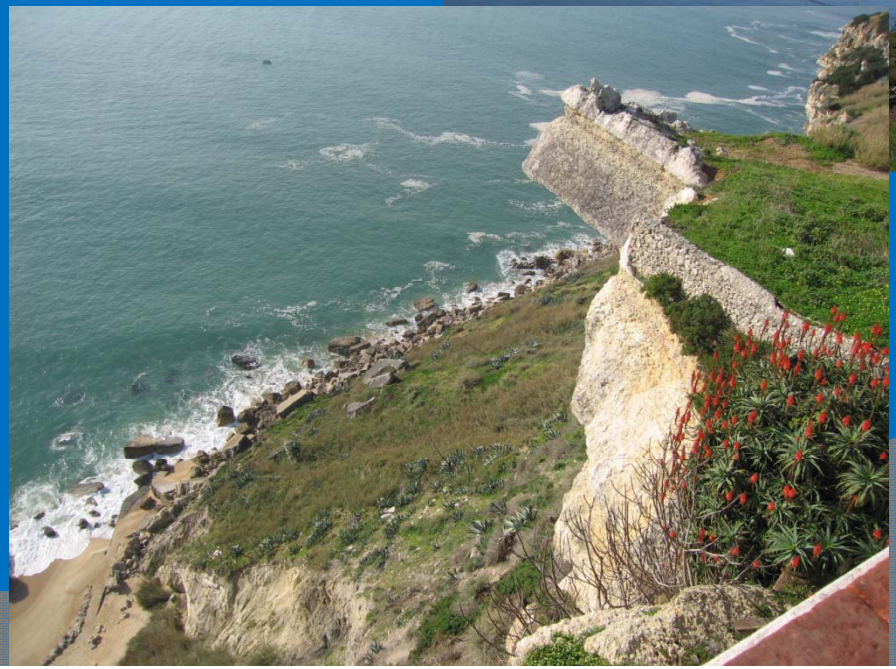
- Urban soils impermeability, artificial drainage systems network and inconvenient location of build areas and infrastructures make urban areas very vulnerable to flood effects on land use.

Global heating impacts on land use

- Negative effects on fauna, vegetation distribution, ecosystems and on agricultural activities;

Global heating impact in coastal and estuarine areas

- Increase of rainfalls and of river and sea level rise produce more frequent risks of floods and coastal erosion;



Global heating impact in coastal and estuarine areas

- Floods and coastal erosion affects ecosystems, infrastructures efficient use, land use and landscape stability;
- Coastal erosion affects dunes and beaches (sand deposition reduction)

Flood consequences on land use and urban areas

Vulnerability factors	Impacts
➢Location in coastal and estuarine areas; ➢Surface impermeability ➢Inefficient and inappropriate drainage systems networks; ➢Urban and building construction in river flood beds	➢Infrastructures and properties destruction; ➢Transports and facilities disturbances; ➢Natural ecosystems degradation and destruction; ➢Housing conditions degradation and destruction; ➢Population displacement; ➢Water quality degradation; ➢Risks for human and animal health.

Adapted from M.J. Alcoforado *et al*. "***Estudos sobre Cidades e Alterações Climáticas***", C.E.G. ,Lisbon University, 2008

Floods in urban and coastal areas Prevention and mitigation

- The drainage system network must be adapted in order to manage larger water volume and to discipline water run-off in natural and urban soil;
- Water accumulation must be increased in permanent or temporary dams;

Floods in urban and coastal areas
Prevention and mitigation

- Urban landscaped areas must be designed to facilitate slow speed water run-off and to reduce the time of water arriving to formal drainage systems (*appropriate ground modeling for landscape areas and roads is essential*);

Floods in urban and coastal areas
Prevention and mitigation

- Natural and marsh ecosystems must be protected from artificial interventions and managed as conservation areas.

Floods in urban and coastal areas Prevention and mitigation

- Erosion sensitive coastal areas must be protected through environmental and landscape engineering processes, avoiding heavy and intrusive intervention techniques.

Floods in urban and coastal areas Prevention and mitigation

- River flood beds must be free of construction and used for green areas or urban agriculture;

Floods in urban and coastal areas Prevention and mitigation

- A strip of coastal area along seashore must stay free of construction;

Floods in urban and coastal areas
Prevention and mitigation

- Urban and industrial areas and beach resorts and facilities must be designed and managed in order to prevent the consequences of sea level rise, water storms and floods.
- *Destructive effects of water storms increase when devastation material is floating or dragged by water streams.*
- Drainage and sewage systems networks must be designed and managed in order to operate even in case of sea level rise.

Floods in urban and coastal areas
Prevention and mitigation

- Urban plans must integrate large green corridors in urban structure to assure built free areas to surface water run-off and to reduce the instantaneous impact of strong rainfalls on road and artificial drainage systems;
- Permanent and temporary dams and ponds may be used for biodiversity protection or recreational activities.

- Principal data and references from “URBKLIM: Climate and urban sustainability. Comfort perception and climatic risks (POCI/GEO/61148/2004), Foundation for Science and Technology/FEDER , coord.Prof.M.J. Alcoforado, Lisbon University.

National Program for Climate Changes

- Portugal has a National Program for Climate Changes (PNAC) since 2001, in order to control and to reduce Greenhouse Effect Gases and to respect Kyoto Protocol compromises and the EU Agreement on Sharing of Responsibilities.

- The Program aims to anticipate climate changes impacts and to propose measures to reduce the negative aspects of these impacts.

- It includes dedicated measures , programs and actions on the following areas:
  - **Energy**
  - **Transports**
  - **Fluorinated Gases**
  - **Agriculture, Forest and Animal Breeding**
  - **Solid Wastes**

National Program for Climate Changes

- Portuguese National Program for Climate Changes does not dedicate direct attention to climate changes impacts on land and urban use, environment and society.

- The governmental Foundation for Science and Technology aids with financial support research projects on these areas.

Climate change and costal and estuarine areas spatial planning

- A research project on climate change in estuarine areas is under way at the Landscape, Urban and Spatial Planning Laboratory of the Faculty of Architecture/TU Lisbon. ("*Urbanized Estuaries and Deltas. In search for a comprehensive planning and governance. The Lisbon case*"– coord. J.P. Costa, L. Fadigas, J.F. Sousa)

- This project aims to study and identify the previsible climate change impact on sea level rise, urban, economic and port uses, after a pre-defined set of scenarios.

Climate change and costal and estuarine areas spatial planning

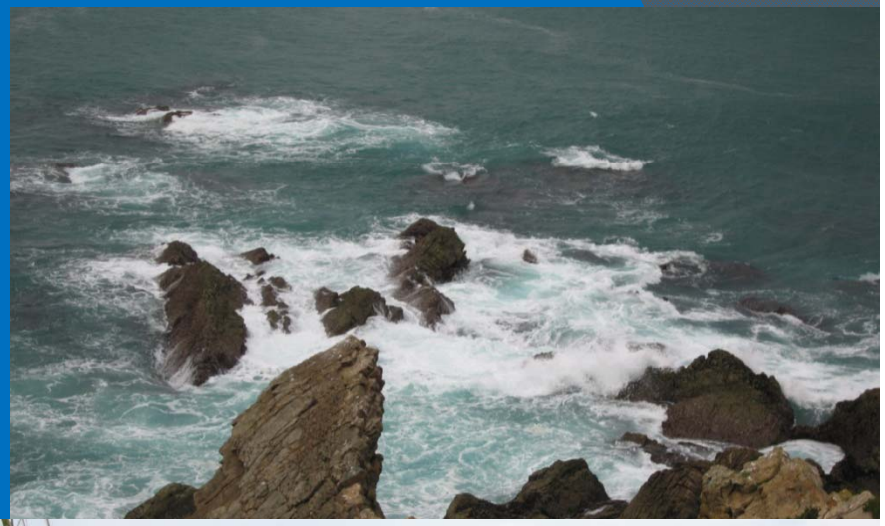
- Coastal and estuarine areas have great environmental sensitivity with a wide variety of uses, providing simultaneously support to various economic activities (fishing, tourism, navigation).
- Climate change impacts may affect their environmental qualities and reduce their availability to those economic activities.

Climate change and costal and estuarine areas spatial planning

- Erosion in the Portuguese coast is a consequence of its chaotic occupancy and the modification of currents and tides after the construction of high impact infrastructures (ports and spikes for beach protection), together with the reduction transport of sediment to the coast.

Climate change and costal and estuarine areas spatial planning

- Coastal erosion is more evident in the areas of coast where sands or other fragile formations has special meaning when there is human occupation on them.



Climate change and costal and estuarine areas spatial planning

- Climate change impacts and sea level rise may intensify coastal erosion and produce severe damages on urban areas and economic infrastructures.
- This emergent reality impose new planning and management policies for coastal areas.
- In this way Portugal adopted, in 1993, a Coastal Land Use Plan law for regulation of coastal areas use.

Climate change and costal and estuarine areas spatial planning

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Climate change and costal and estuarine areas spatial planning

- Coastal Land Use Plans were created as Special Plans and a framework to lead to the improvement, enhancement and management of resources on the coast.
- At the moment all Portuguese continental non urban coastal areas managed is made according to them.
- Coastal Land Use Plans cover a strip along the coast, with a maximum of 500 m width, starting from the limit of the margin of the sea, adjustable where appropriate, and a range of maritime protection till the bathymetric – 30m.

Climate change and costal and estuarine areas spatial planning

- **Coastal Land Use Plans objectives**:

- Order the different uses and specific coastline activities;
- Order the beaches and regulate their bathing use;
- Enhance and improve the beaches considered strategic for environmental reasons and tourism;
- Fit the development of specific coastline activities;
- Ensure nature protection and conservation.

Climate change and costal and estuarine areas spatial planning

- Coastal Land Use Plans concern particularly with the biophysical space protection and integrity, with the exploitation of existing resources and the conservation of environmental and landscape values.
- **Coastal Land Use Plans** are not directly involved in climate changes concerns but are **an useful tool for seashore evolution control and to prevent and mitigate unexpected and dangerous sea level rise and sea storms impacts.**