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# Valuation of environmental and economic impacts of sea-level rise in the Basque coast under different climate change scenarios based on the recent geological record

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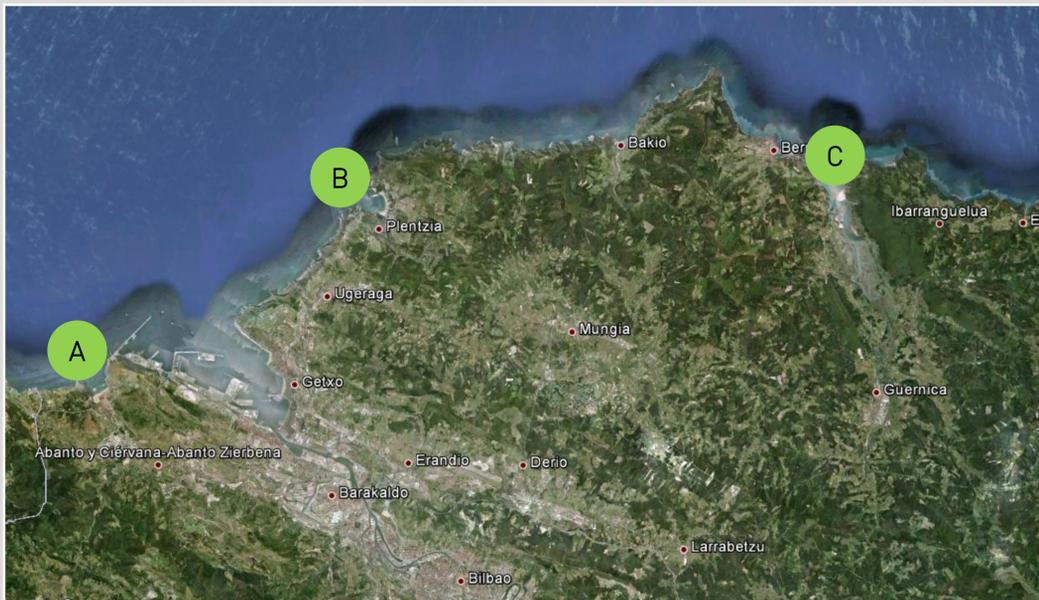
## 1 INTRODUCTION & OBJECTIVES

Among the projected impacts of climate change, changes in sea level pose a major threat to coastal areas. These impacts are expected to be particularly serious considering that much of the world's population is concentrated in these areas. The Basque Coast, is no exception.

This thesis project considers and complements a **geological approach**, from which to analyse and design different scenarios of recent changes in sea level, together with a **socioeconomic approach**, which translates and monetizes the biophysical impacts on different natural coastal ecosystems, through three case studies on industrial, urban and natural areas. Additionally, we analyse the role of environmental services provided by wetlands on damage mitigation due to sea-level rise and, finally, the thesis deals with a cost-benefit analysis of the adaptation policies that could be implemented.

## 3 SELECTED CASE STUDIES

Based on the geological scenarios of sea-level rise, maps of future flooded areas will be built for 3 sites of the Basque coast:



### MUSKIZ

The estuary of Barbadun has been selected to analyze the impacts of sea-level rise (SLR) on an industrial land with high economic activity (Petronor refinery).

### PLENTZIA

The case study in Plentzia will assess the impacts of SLR in urban land.



### URDAIBAI

The influence of SLR on different **natural coastal ecosystems** will be studied in the Urdaibai Biosphere Reserve.

## 2 BUILDING SCENARIOS FROM GEOLOGY

Different recent climatic episodes within the Quaternary period will be used to build the scenarios for future sea-level rise, as shown in the table below. Three of the scenarios are taken from the results obtained by the Harea-Geología Litoral Research Team (Leorri and Cearreta, 2009).

Geological episode	Rate of sea-level rise	Sea level in 2050	Sea level in 2099
Anthropocene (1900 AD-today)	1.9mm/yr	+72,2mm	+165,3mm
Holocene 1 (3000 BP-1900 AD)	10mm/ yr	+380mm	+870mm
Holocene 2 (7000-3000 BP)	0,7mm/ yr	+26,6mm	+60,9mm
Eemian (125.000 BP)	Under construction		



The outcrop of Oyambre, unique in the Cantabrian coast, shows materials from a paleobeach 7-8m above present sea-level (Reference: 0 from the Port of Bilbao).

Although the materials are still to be dated, the hypothesis is that they represent the **Eemian interglacial**, where global temperature is estimated to be 1-2°C higher than today and global sea-level ~5m above.

## 4 THE RESPONSE OF SALTMARSHES TO SLR

Wetland losses are driven by the rate of sea-level rise rather than the total rise, as they have capacity to respond to inundation (Roman *et al.*, 1997).

The response of saltmarshes to inundation has been studied in several wetlands of the Basque coast (Muskiz, Plentzia, Urdaibai) and it will also be addressed in the selected case studies with two objectives:

- To analyse the impacts of sea-level rise on saltmarsh ecosystems.
- To estimate the role of wetlands as a soft adaptation measure to face climate change consequences on the coastal area..

## 5 ECONOMIC VALUATION OF IMPACTS

Based on the maps of flooded area for each case study, the following steps will be performed:

- Identify the affected elements (e.g. industries, households, ecosystems).
- Estimate the direct and indirect costs of the damages due to sea-level rise.
- Estimate the costs for protection of potentially affected areas and infrastructures.
- Carry out a cost-benefit analysis of adaptation strategies to face the impacts of sea-level rise.

## 6 ADAPTATION POLICY RECOMMENDATIONS

There will be a comprehensive review of adaptation policies defined by reference countries in combating climate change. The review will place particular emphasis on those adaptation strategies that include the economic analysis in their design and implementation.

Once that costs and benefits of different adaptation policies is carried out, there will be a prioritization of measures and instruments that best fit with the case studies. Data from other studies will be duly transferred and adjusted to the situation of the Basque Country.

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