

# Coastal Erosion from Space



## In-situ information for validation – Spain

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## Applicable and reference documents

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Id	Description	Reference
AD-1	Product Validation Plan	SO-TR-ARG-003-055-009-PVP

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## 1 Introduction

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Spain has a long-varied coastline which can be divided in 6 different areas depending on its characteristics. The Cantabrian sea is characterized by rocky headlands and pocket beaches, sand spits and small estuaries, whereas the Atlantic area is characterized by larges estuaries and some sandy beaches in the estuaries or tombolo. The Gulf of Cadiz presents long sandy beaches with dunar systems and large wetlands. The Mediterranean coast is also characterized by long sandy beaches but with low rocky cliffs, and a variety of coastal structures, deltas and coastal lagoons. The Balearic islands are mainly composed of rocky coasts and pocket beaches, wetlands and coastal dunes. The Canary islands is characterized by rocky steep shores with high cliffs on the norther of the islands and sandy beaches on the southern areas.

The coastline of Spain is vulnerable to coastal flooding and erosion, as well as to urban developments.

## 2 Barcelona and Tordera Delta

Barcelona pilot site spans 17 km from the mouth of El Prat river to Port Ginesta.

Easterly swells propagating from the Mediterranean Sea provide the dominant wave climate and the westward natural littoral drift drives sediments from El Prat towards Port Ginesta. The construction of dams and dykes along river banks along El Prat river in the last few decades has reduced the river sediment yield. Additionally, the coastal structures of the Port of Barcelona block updrift sediments. These two factors are the reason of a chronic erosion west of El Prat mouth. The eroded sediment in this area is accumulated downdrift, next to the main breakwater of Port Ginesta. Erosion values of 0.7 m/y have been observed.



**Figure 2.1 Erosion and accretion in the Barcelona beach**

The Port Authority is responsible for the restoration of the lost natural equilibrium and therefore since 2007 is making a sediment back-pass twice: Sediments are dredged from Port Ginesta and deposited west of El Prat river mouth.



**Figure 2.2 Sand back-pass performed in Barcelona beach**

Tordera Delta spans 11 km from Blanes on the east to Pineda del Mar to the west.

The sediment yield of the Tordera river has decreased due to upstream construction of dykes and dams. Additionally, the delta used to have multiple mouths so river discharge distributed sediments along the whole delta and sediments were deposited on-shore during floods. Nowadays there is a single mouth and therefore sediments are often deposited off-shore, deeper than the closure depth of the beach profile. The Port of Blanes (on the eastern boundary of this site) blocks sediment updrift (littoral drift is directed to the west) and therefore there is a sediment deficit in the site that leads to the progressive erosion of the whole delta. A mean erosion rate of 1.25 m/y have been observed between 1957 and 2009.



**Figure 2.3 Tordera delta erosion between 1957 and 2009**



### 3 Port of Castellón and Port of Sagunt

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The area is located between the ports of Castellon and Sagunto. It is characterized by sandy beaches with some gravels, multiple small groynes, revetments and detached breakwaters. The beaches are backed by urban esplanades, agricultural lands and wetlands. These ports have split the original littoral cell into smaller cells, producing local lack of sediments and consequent shoreline setbacks. The beaches located in this area present erosion in the north and accumulation in the south, with averaged rates of -1.5 m/y and +0.8 m/y, respectively, between 1984 and 2009.

## 4 Cadiz and Mazagón Beach

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The beach of Cadiz is suffering from erosion at the southeast part, with erosion rates up to 1 m between 2001-2011, whereas in the middle part of the beach, progradation of 0.3 m between 2001 and 2011 is observed.

The Beach of Mazagón has experienced an erosion of circa 30 m in the last 20 years in the northwest part of the beach, whereas the southeast part of the beach has been stable between 2001 and 2011.

## 5 Salinas

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Salinas is a sandy beach located between a rocky headland to the west and a 400 m-long groyne to the east (at the mouth of the estuary of Aviles). Between 1998 and 2010 the beach has experienced an erosion at the western part of the beach, whereas an accretion has been observed at the eastern part. The erosion observed at the western part of the beach gradually increases from the west to the east, reaching values from 0.1 m at the rocky headland, up to 3.9 m at the centre of the beach for that period.

## 6 El Puntal of Santander

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El Puntal of Santander is a 2.5 km-long spit of fine sand (median grain size 0.3 mm). This spit encloses the estuary of the river Miera in the Bay of Santander. Between Punta Rabiosa and Somo (west to mid-east part of the spit), a retreat of 2.7-3.3 m/y has been observed between 1875 and 2014. This means a total of  $415 \pm 40$  m of total retreat for the period. The eastern part of the beach, Las Quebrantas beach, suffered a retreat of 407 m with an uncertainty of 40 m from 1875 to 2017. The erosion rates were 3-3.8 m/y for the period 1875-1985, whereas an erosion rate of 1m characterizes the period between 1985-2017.

## 7 San Sebastian

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Three urban beaches located in the municipality of San Sebastian between rocky headlands and the groynes at the mouth of Urumea estuary and backed by an esplanade.

The three urban beaches, Ondarreta, La Concha and La Zurriola, are affected by erosion due to the gradual human invasion throughout the 20<sup>th</sup> century. They experience major erosion due to winter storms. Particularly, cobbles and boulders appear on the sandy beach of Ondarreta on a regular basis after erosional events. Sea level rise from 2001 to 2099 will increase between 28.5 and 48.7 cm in this area.

## 8 Maspalomas

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Maspalomas is located at the south coast of the island of Gran Canaria and is characterized by a beach of 5.5 km length and by sand dunes. The western half of the beach (Playa de Maspalomas) is oriented towards the south whereas the eastern half of the beach (Playa el Inglés) is oriented towards the east. Punta de la Bajeta is located at the centre of this coastal stretch.

Under normal conditions NE winds bring sand into the system through Playa del Inglés, where it is transported inland to form dunes that advance until they reach the sea through Playa de Maspalomas. When storms with heavy SW wind occur, the Maspalomas beach is eroded and the sand is deposited in Punta de la Bajeta, where part of it is lost into the sea.

This beach is characterized by highest beach erosion rates during winter, with a decadal recovery period to their initial states. For the period between 2005 and 2009, El Ingles beach presented a stable shoreline. Maspalomas beach showed an average accretion of 60 m, whereas La Bajeta cape presented a retreat higher than 100m. The submerged area for the period 2000-2007 showed a net erosive trend, with values of 1m. The highest erosion rates (2 m) were in two different areas, the shallowest sector southward of Maspalomas beach and the deepest sector eastward of El Inglés beach. The east of La Bajeta cape and southward from Maspalomas beach showed accumulative trends of about 2m. Finally, the inner shelf fronting La Bajeta cape had a balanced sediment budget.

## 9 Las Canteras

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Las Canteras is in the northeast of the island of Gran Canaria in the west side of the Guanarteme isthmus, between the rocky headland of La Puntilla to the east and the breakwaters Los Muellitos to the west.

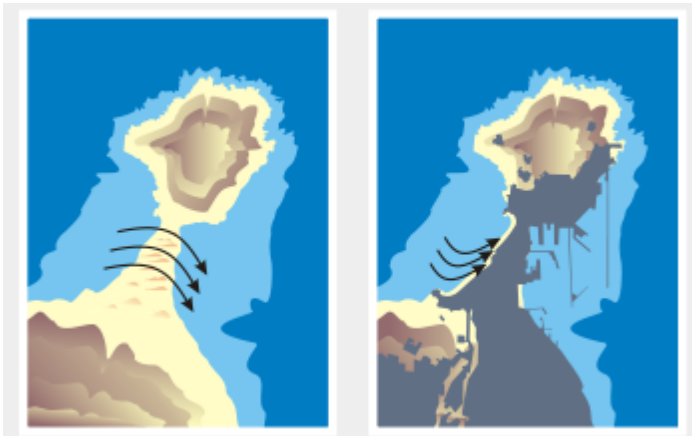
The beach is divided in three sections: south (Cicer beach), central (Chica beach) and north (Grande beach). The central and north section is protected by an emerged rocky reef located in front of the beach. All three sections are backed by an esplanade and urban developments.

Until the 19th century the Guanarteme isthmus was covered by a dune field, the wind transported sand from Las Canteras to the east side of the isthmus.



**Figure 9.1 Guanarteme isthmus in 1880.**

Currently, the beach of Las Canteras experiences the accumulation of sediments blocked by the urban developments in the isthmus that hinder aeolian sediment transport from the west to the east side.



**Figure 9.2 Previous aeolian sand transport (left) and current accumulation of sand in Las Canteras.**

The main accumulation of sand is in the north of the beach causing the reduction of water depth between the shoreline and the detached reef in front of the beach.





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