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WAVE TRANSFORMATION ON SHORE PLATFORM AND ADJACENT SANDY BEACH - SOUTHERN PORTUGAL

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1. Introduction

The knowledge on coastal processes is not only of basic and practical importance (for instance in engineering applications) but also of socio-economic relevance. Crenulated coasts are complex geomorphic environments where both erosive (into headlands) and depositional processes (in embayed beaches) occur simultaneously. Waves represent an important morphogenic factor and the most important source of energy to coastal zones. However, field data reporting the interaction between waves and rocky coastal features is still scarce, leading to a poor understanding on rates and drivers of surf attenuation at rocky shores. Waves abrasion and erosion on shore platforms depend on the platform properties, morphology of the adjacent continental shelf, and water depth upon the platform surface, which is controlled by tides, available sediment and wave climate (e.g., Stephenson and Kirk, 2000; Marshall and Stephenson, 2011). Shore platforms extending in the intertidal zone at the rocky cliffs' toe are natural morphological barriers to wave propagation and energy attenuation (Ogawa et al., 2011). Over short time scales the beaches in a crenulated coast are modified mainly by waves causing setup and set down in the surf zone leading to a very complex pattern and circulation modified by the interaction between the currents induced by waves and the incident waves. The mechanisms involved in morphological modifications in those environments are still not well understood (Silva et al., 2010).

This work aims to compare the waves behavior both on a shore platform and adjacent pocket beach in response to exactly the same offshore wave conditions.

2. Study Area

The study area is located in the Central Algarve rocky coast, in Galé beach (Figure 1), well exposed to W-SW wave conditions. In this sector the rocky cliffs and the shore platform are carved in a Miocene calcarenite formation. The coastline is crenulated, with headlands protecting pocket beaches and bay beaches.

Waves approaching from WSW representing 72% of the year are normal to the shoreline at Galé (NW-SE orientated). Dominant offshore significant wave height (H_{so}) is less than 1 m, with storms occurring when H_{so} > 3 m for less than 2% of the year (Costa et al., 2001). The Algarve coast experiences a semi-diurnal mesotidal regime ranging with tidal ranges from 1.3 m during neap tides to 3.5 m at spring.

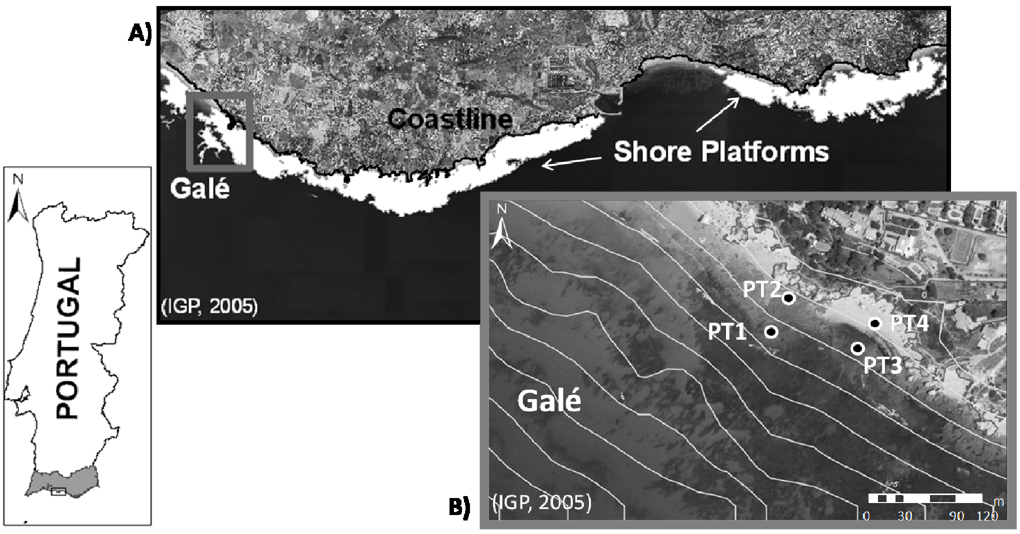

Figure 1. A) General view of the study area. B) Position of the sensors, PT1 and PT2 in the shore platform and PT3 and PT4 in the pocket beach.

3. Methods

Four pressure transducers (PT) were placed in the study area (Figure 1 B)), on the platform (PT1 and PT2) and in the adjacent sandy beach (PT3 and PT4). They acquire simultaneously the full wave spectrum, through measurements with a frequency of 2 hrz for a tidal cycle. The data acquisition was collected for two different periods corresponding to different offshore conditions. The sensors position and the bottom profile for every campaign was obtained using a dGPS. Parameters such as significant wave height (H_s), significant wave period (T_s), wave energy and power, wave height and water column at break conditions (H_b and h_b, respectively), were obtained in post-processing. The offshore data was obtained in the Hydrographic Institute (IH) Faro buoy.

4. Results and discussion

The Table 1 synthesize the observed conditions for both offshore (IH buoy) and nearshore sites (PTs measurements), and also the wave transformation that occur between them.

The wave conditions measured at Galé clearly show a good exposure to WSW conditions and a protected position in what concern SE conditions as demonstrated by the differences in Hs between data from the offshore buoy and the PTs measurements (Table1).

Besides the offshore data indicate more energetic conditions for the SE direction, the nearshore measurements in Galé showed higher Hs values for WSW conditions due to a site effect. In this situation, both platform and beach act in a dissipative way, between the outer sensors (PT1 and PT3) and the inner sensors (PT2 and PT4). Considering the lowest energetic condition (SE) the dissipation observed upon the shore platform was less significant than for higher Hs. A shoaling effect was observed in the beach, yet being a more protected place for SE incoming waves. This slight increasing in wave height in the innermost PT4 may be explained by the bottom effect. When the water column decreases the wave interacts with the seabed resulting in a increase in wave height.

Table 1. Synthesis of the wave data both in offshore and nearshore conditions, and wave transformation.

Offshore wave conditions	Sensor	H_b (m)	Wave transformation	
WSW H_s = 1.14m T_s = 6.45s	PT1	1.367	Offshore to nearshore	17% shoaling
	PT2	0.944	Nearshore platform (PT1 to PT2)	31% dissipation
	PT3	1.563	Offshore to nearshore	27% shoaling
	PT4	0.703	Nearshore beach (PT3 to PT4)	55% dissipation
SE H_s = 1.91m T_s = 5.81s	PT1	1.183	Offshore to nearshore	18% dissipation
	PT2	1.105	Nearshore platform (PT1 to PT2)	7% dissipation
	PT3	0.861	Offshore to nearshore	55% dissipation
	PT4	1.091	Nearshore beach (PT3 to PT4)	21% shoaling

5. Conclusions

The behaviour of waves propagation upon the shore platform depends mainly on the relationship between the coastline orientation and the offshore wave direction. The higher Hs in the outer PTs both in the platform and beach the more significant wave dissipation was observed.

Acknowledgments

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