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Shadowing Effects on Beach Morphodynamics During Storm Events on Tróia-Sines Embayed Coast, Southwest Portugal

J. Jacob†, C. Gama‡, R. Salgado∞, J. T. Liu§ and A. Silva***

† FCMA/CIMA
Universidade do Algarve
Campus de Gambelas
8005-139 Faro, Portugal
jjacob@ualg.pt

‡ C. G. E
Universidade de Évora
Colégio Luís Verney,
Rua Romão Ramalho, 59
7002-554 Évora, Portugal
cgama@uevora.pt

∞ C. G. E
Universidade de Évora
Colégio Luís Verney,
Rua Romão Ramalho, 59
7002-554 Évora, Portugal
rsal@uevora.pt

§ Institute of Marine Geology & Chemistry
National Sun Yat-sen University
Kaohsiung, Taiwan
80424, ROC
james@mail.nsysu.edu.tw

*** C. G. E
Universidade de Évora
Colégio Luís Verney,
Rua Romão Ramalho, 59
7002-554 Évora, Portugal
asilva@uevora.pt

ABSTRACT

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The prediction of storm effects on coastline is essential to coastal management and represents a critical issue for the scientific community discussion. In this paper we used SWAN and Méso-NH models to simulate the wave pattern along a ten's kilometre-scale sandy coastline (TSEC, Tróia-Sines Embayed Coast). The obtained results indicate a shelter effect of the Espichel Cape in the northern half of the TSEC for wave climate from the NW-WNW. Under these conditions, the wave height increases in the southward direction and the Setúbal submarine canyon locally influences entire TSEC. The influence of the Espichel Cape and the Setúbal Canyon decreases with the rotation of the wave direction from the NW to W direction. The alongshore wave energy gradient disappears with wave climate from SW and the TSEC is directly exposed to incident waves during storms. The results of modelling seem to explain volumetric changes observed in the TSEC (Tróia, Comporta, Aberta Nova, Santo André and Ribeira de Moinhos), under the effect of seven surveyed storms.

ADITIONAL INDEX WORDS: *SWAN, Meso-NH, wave propagation, storm, sandy coastline, beach volumetric changes.*

INTRODUCTION

Variations in the frequency and magnitude of storm events and the ability of the littoral system to respond are important features to proper evaluate future effects of climate changes on the littoral erosion (e.g. LOZANO *et al.*, 2004; RANASINGHE *et al.*; 2004, LEE *et al.*, 1988; HILL *et al.*, 2004). In sandy coastlines, the understanding of the effect of storm incidence in beach morphodynamics is therefore crucial for coastal management.

In this study, the SWAN and Méso-NH models were coupled to estimate the wave parameters, along an embayed sandy coastline, under the effect of storms events.

The Tróia-Sines embayed coast (TSEC) corresponds to a sandy coastline that extends for 65 km, between the Sado Estuary and the Sines Cape on the southwest Portuguese coast. The wave climate data obtained in the Sines wave rider buoy (37º 55' 16'' N, 8º 55' 44'' W; water depth = 98 m) show for the offshore waves a mean significant wave height (Hs) and peak period (Tp) of 1.7 m and 10.8 s, respectively. Hs values ranging from 1 m up to 2 m represent 49% of the occurrences whereas, 10% of the obtained results correspond to Hs values higher than 3 m. For the peak period, 60% of the Tp values range between 9 and 13 s. The wave direction during the peak period is dominated by the NW sector (77.3%), followed by the W (20%), SW (2.4%) and S (0.2%) sectors (COSTA *et al.*, 2001). This shoreline is located in the lee side of the Setúbal peninsula that includes the Espichel Cape (Figure 1).

This natural protection prevents the direct arrival of large amounts of wave energy from the dominant NW direction to the shore. This protection effect decreases towards southwest and is responsible for wave energy gradients that control alongshore and offshore sediment transport and dispersal. However, during storms and/or swell from W and SW the TSEC remains totally exposed (QUEVAUVILLER, 1987; ABECASSIS, 1987; GAMA, 2005).

The aim of this work is to investigate the storm waves and wind patterns of the most common storm events that occur in the TSEC, considering the volumetric changes occurred in the subaerial beaches. In order to simulate waves induced by storms, considering the local wind, the phase averaging spectral wave model SWAN (Simulating WAves Nearshore), was used in a stationary mode, coupled to the Méso-NH (Mesoscale Non-Hydrostatic) atmospheric model. The hindcast of seven storms events between December 1998 and February 2001 were performed.

The results were compared with the cross-shore volumetric changes surveyed in five beaches along the TSEC (Tróia, Comporta, Aberta Nova, Santo André and Ribeira de Moinhos beaches).