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Moving sands along a headland-embayed beach system (Algarve, Southern Portugal)

Sónia Oliveira, João Horta, Ana Nascimento, Ana Gomes, Cristina Veiga-Pires, and Delminda Moura
University of Algarve Centre for Marine and environmental Research

Resilience of embayed and pocket beaches located at the southernmost coast of Portugal is currently a major question to coastal management of this region. In fact, several among those beaches have been artificially fed aiming to increase the width of the beach allowing people to maintain a safe distance to the unstable rocky cliffs. The sand is dredged from the offshore (ca. 2 miles from the shoreline) representing high costs for the Portuguese government. For how long will the artificial feeding solve the problem? Which beaches are worth being nourished taking into account the morphosedimentary processes? The present work is the result of a field experiment aiming to study the efficiency of the alongshore sedimentary transport between successive embayed beaches. The experiment was performed in the very indented rocky coast of the Algarve region (Southern Portugal) and comprised two field campaigns, both in 2014, during spring tides in March and November. The Algarve coast experiences a semi-diurnal meso-tidal regime ranging from 1.3 m during neap tides to 3.5 m at spring tides and the waves approach from WSW (232°) during 72% of observations along the year, almost normal to the study area shoreline. The wave and current characteristics (significant height-Hs and Period-T for waves, velocity and direction for currents) were measured during three and six tidal cycles respectively for the first and second campaign, using two pressure transducers and one electromagnetic current meter. We used sand painted with orange fluorescent dye (100 kg in March and 200 kg in November) as tracer to track the movement of the sand along the coast. The marked sand was placed on the beach face of the westernmost beach of the study area during the first low tide of each campaign. Following, hundreds of sediment samples were collected during low tide, through the monitored period, in the nodes of a georeferenced square mesh of 10 x 20 m covering three embayed beaches. Later in the laboratory, sediment was characterized concerning the grain size distribution and the marked grains (MG) which were identified and counted with the use of a black light. After statistical analysis, several maps were developed in a Geographical Information System in order to quantify and interpret the direction and velocity of the movement of the sand induced by the observed waves and currents. The results of this work showed that: (i) when the existing shore platforms between adjacent embayed beaches are exposed, their surface is topographically higher than the beach face and strongly dissected by channels (e.g., joints) and karstic cavities, and thus the transference of sand between the adjacent beaches is almost nil, (ii) when a topographic continuity was observed between the beach face and the surface of the shore platforms, the transference of sand between adjacent cells is effective. The two reported situations depend on the beach morphosedimentary processes driven by the angle between the waves and the shoreline. This work is a contribution to the PTDC/GEO-GEO/3981/2012 funded by the Portuguese Foundation for Science and Technology. The authors would like to thank the collaborators of the November campaign: A. Rosa; A. Portugal; A. Silva; C. Correia, J. Cunha e L. Castilho.