Hydro-sedimentary processes in a beach-headland system

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Understanding hydro-sedimentary processes in space-limited environments as embayed beaches is a key question to reconstruct preterit and predict future coastal evolution forced by the mean sea level rise. Moreover, such knowledge is a fundamental management tool in areas where coastal erosion is currently a worrying fact. This work aims thus to assess the sedimentary contribute, provided by the alongshore transport, to feed embayed beaches.
At the southernmost rocky coast of Portugal (Algarve), beaches occurring at the cliffs' foot are separated by headlands connected to shore platforms forming littoral cells as a consequence of the extremely karstified carbonate landscape. The survival of those beaches depends almost exclusively on the alongshore drift.
In order to assess the effectiveness of the sedimentary transport induced by diverse wave climate, we used marked sands and tracked their path during a total of nine tidal cycles (two field campaigns: March and November, 2014). For this, we sampled in each cycle at the nodes of geo referenced net along the coast. Additionally, topographic surveys were done to determine the relationship between the wave heights, the morphodynamic state of the beaches and the grain size distribution. Numerical models were used to simulate the nearshore hydrodynamics to be correlated to the sand transport pathway and velocity.
During the field experiences the waves approached the coast from WSW (243°- 263° March and November respectively) and the mean significant wave height ranged from 1.1 m-1.5 m. The morphodynamic state of the beaches was mainly reflective. The most different morphodynamic aspect between the two field campaigns was the topographic continuity between the shore platform and the beach surface. In opposition to November conditions, during the first campaign in March, the surface of the rocky platform was at least 50 cm higher than the beach surface. The pattern of the grain size distribution was always parallel to the shoreline ranging from coarse sand at the backshore and high tide terrace to medium sand at the beach face with patches of fine sand close to the low water level of spring tide. During the first phases of the rising tide the cellular circulation was more important than the alongshore currents whereas current pattern and therefore sediment transport were determined by the beach morphology and dimensions during the last phase of the high tide.
Our results show that: (i) when waves approach perpendicularly the coast, the shore platforms induce strong variation on the wave shoaling and the resultant rip currents favour the cross-shore transport direct towards sea, (ii) strong morphological control of the hydro-sedimentary processes in the studied beach-headland leads to an inefficient downdrift transport of sand. The, narrowing of the beaches will be a natural consequence of the sea level rise due to the lack of sediment and the limited accommodation space and, once they as they act as buffer dissipating the wave energy, the cliff erosion and retreat is expected to increase.

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