Geophysical Research Abstracts
Vol. 16, EGU2014-14602, 2014
EGU General Assembly 2014

Headland sediment bypassing and beach rotation in a rocky coast: an example at the western Portuguese coast

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Headland sediment bypassing plays a major role in definition of coastal sedimentary budget and consequently in coastal management. This process is particularity important at headland-bay beaches on rocky coasts. However, headland-bay beach research is usually focused on the beach rotation since these beaches are generally regarded as closed systems. The sediment bypassing mechanisms have been extensively studied in the context of artificial structures (e.g. groins and jetties) but studies of natural headland sediment bypassing are scarce and usually applied to decadal time scales. This work aims to contribute to the understanding of headland sediment bypassing processes in non-artificial environments, taking as a case study a natural coastal stretch at the Portuguese west coast. The study is supported on the analysis of planform beach changes using Landsat satellite images (with an acquisition frequency of 16 days) complemented with field surveys with DGPS-RTK and ground-based photographic monitoring.
The study area can be described as a cliffed rocky coast that accommodates a series of headland-bay beaches with different geometries: some are encased in the dependence of fluvial streams, while others correspond to a narrow and elongated thin sand strip that covers a rocky shore platform. This coast is generally characterized by a weak, but active, sediment supply and high levels of wave energy due to the exposure to the swells generated in the North Atlantic. The long-term stability of the beaches in conjunction with active sediment supply along the study area (from streams and cliff erosion) and a sink at the downdrift end of this coastal stretch (an active dune system) support the existence of headland sediment bypassing.
The analysis of planform beach changes show a coherent signal in time but with a range that depends on the orientation of the stretch where each beach is included. In general, beaches displays a clockwise rotation during summer related to the NW (less energetic) incident wave conditions. The persistence of these conditions induces an enlargement of the beach downdrift (southward) and eventually sediment bypassing. This process can result in a continuous inner bar along the headland coast, which migrates downdrift in the surf zone and weld to the downdrift beach. The counter-clockwise rotation observed in the winter is more variable being in agreement with the less persistent W and SW incident wave conditions, suggesting that sediment bypassing occurs only southwards.

The work was funded by FEDER funds through the Operational Programme for Competitiveness Factors - COMPETE and FCT National Funds - Portuguese Foundation for Science and Technology under the project Beach to Canyon Head Sedimentary Processes (PTDC/MAR/114674/2009). First author benefits from a PhD grant funded by FCT (SFRH/BD/79126/2011).