Geophysical Research Abstracts
Vol. 16, EGU2014-14268-1, 2014
EGU General Assembly 2014

North beach (Nazaré) sand tracer experiment

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The littoral in the vicinity of Nazaré (West Portuguese coast) is characterized by two distinct coastal stretches separated by Nazaré headland: a northern sector (Norte beach) characterized by a high energetic continuous sandy beach and a southern sector (Nazaré bay beach) that corresponds to an embayed beach, sheltered by the Nazaré headland. The bay is a geomorphological expression of the Nazaré canyon head, which acts as powerful sediment sink, capturing the large longshore net southward transport at Norte beach generated by the north Atlantic high energetic swell.
The northern side of the canyon head is carved on highly resistant Cretaceous limestone sustaining an underwater vertical relief that emerges on the Nazaré headland, creating a unusual nearshore wave pattern. This wave pattern not only concentrates high energy levels at the Norte beach but also contributes to local complex longshore drift gradients capable of inducing beach seasonal cross-shore variations of more than 200 m. The main factors that influence local sediment budget are: (1) canyon head capturing and (2) headland sediment bypassing.
To obtain a direct measure of the net longshore drift at Norte beach (upstream boundary of the system) a large scale fluorescent tracer experiment was performed. The data will be used to validate longshore transport formulas in a high energetic environment and to access Nazaré canyon head sediment loss.
Considering the anticipation of high transport rates, approximately 10 tonnes of native sand where coated with orange fluorescent ink using a set of concrete mixers. The experiment took place on the 9th to 15th September 2013 period and followed the continuous injection method (CIM). The CIM approach was justified by the expected high energy levels that inhibits sediment sampling across the surf zone. During the tracer injection procedure (approx. 5 hours), sediment sampling was performed at 13 sites along a rectilinear coastal stretch extended through 600 m downdrift of the injection point. Tracer was injected at a rate of 16 kg each 30 sec and collected at a frequency of 10 min at each site. Complementary sampling was performed at the inner shelf and at the beach southern of the headland. In order to follow tracer downdrift movement and headland sediment bypassing low resolution sampling was extended through three more days. Oceanographic forcing throughout the experiment was measured by an offshore wave buoy and an ADCP specifically deployed for the experiment.
During the first tidal cycle, data from field observations using a hand held UV light showed a southward tracer displacement of more than 600 m. After the second tidal cycle, sediment tracer was detected in the Nazaré bay beach showing headland bypassing. Further insights on the sediment transport at the Nazaré canyon head system will be supported by the analysis of sediment samples collected at the beach and inner shelf using an automated image analysis system.
This work was done in the framework of the PTDC/MAR/114674/2009 program, financed by FCT which the authors acknowledge gratefully.