INCLUSION OF PUNCTUAL LONGSHORE DRIFT ESTIMATIONS IN THE SEDIMENT TRANSPORT CONCEPTUAL MODEL AT EL FANGAR SPIT (EBRO DELTA, SPAIN)

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1. Introduction

The longshore sediment transport is one of the most determinant processes in the evolution of littoral spits. Therefore, the determination of this transport rate has a very important role in the study of the system evolution. The aim of this work is to integrate the longshore drift estimations based on punctual field measurements taken between April 11th and 13th 2011 in a beach at El Fangar Spit (Ebro Delta, Spain) (Ribeiro et al., 2012) into the longshore sediment transport conceptual model proposed by Jimenez (1996). The field campaign included a fluorescent tracer experiment, measurement of suspended sediment concentration (SSC) and wave and current forcing.

2. Data acquisition

During the field campaign conducted on April 2011 a fluorescent tracer experiment by the spatial integration method was performed. The beach profile was surveyed with DGPS. The short-term profile changes and the mixing depth were evaluated by measuring the height variations and sediment thickness over loose-fitting on rods placed across the beach profile. Simultaneous measurements of waves and currents times-series were obtained, using a pressure transducer (PT) and an electromagnetic current meter (ECM), respectively, at a fixed point in the outer surf zone and at six different locations across the surf zone. The wave parameters were computed using standard spectral analysis (Kamphuis, 2000). Optical Backscattering Sensors (OBS) and sediment traps were used to measure the SSC. Wind data were obtained from a meteorological station placed at L'Ampolla port (approximately at 6km northwards). The 2000 and 2012 coast lines surveyed with DGPS were employed to deduce long-term transport rates.

3. Transport estimation

Short-term longshore drift was estimated from: 1) the tracers experiment using the Komar & Inman (1970) approach (Eq. 1, where b is the mixing depth, X_b is the width of beach under the influence of the breaking waves and $\bar{V}$ is the average mass center velocity of the tracer); 2) with the SSC, the current longshore velocity and the water depth measure across the surf zone profile; and 3) the empirical formulation of Komar & Inman (1970) (Eq. 2, where $K=0.77$, E is total wave energy, C_n is the wave group velocity and α_b is the wave breaker angle). The coast line evolution was used to coarse estimate the long-term longshore transport rate (Eq.3 adapted of Jimenez and Sánchez-Arcilla (2004)), where $\partial\eta/\partial t$ is the cross-shore variation of the shoreline with respect the time measured as a shore-normal transect length variation in the time interval, Q/s is the net longshore transport estimated for a longshore length s, and D is the closure depth (7 m in the Ebro Delta (Jimenez and Sánchez-Arcilla, 1993)). The transect origin has been defined at an arbitrary on-shore point for which we assume as boundary condition a zero variation with time.

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$$Q = b \cdot X_b \cdot \overline{V} \tag{1}$$

$$I_l = K \cdot (E \cdot C_n)_b \cdot \sin \alpha_b \cdot \cos \alpha_b \tag{2}$$

$$\frac{\partial \eta}{\partial t} = -\frac{1}{D}\frac{Q}{s} \tag{3}$$

4. Results and discussion

During the experiment, incident waves at the break point were characterized by a significant height of 0.36 m, a mean zero-crossing period of 4s and a breaking wave angle 12º. The longshore currents ranged from 0.24 $m \cdot s^{-1}$ to 0.62 $m \cdot s^{-1}$ and were direct southward. The longshore current showed a high correlation with the wind coming from the NW direction. The longshore drift rates obtained with the different methods are summarized in Table 1.

Table 1. Longshore drift estimations

Time scale	**Method**	**Q ($m^3 s^{-1}$)**	**Direction**
Short-term	Tracers	6.90E-03	Southward
	OBS	1.40E-04	Southward
	Eq. 2	3.10E-03	Southward
Long-term	Eq. 3	1.21E-03	Northward

Tracers and shoreline evolution estimates yielded a similar magnitude. The differences with the estimates based on SSC measurements could be explained by the fact that this method does not account for the bedload which, in a low energetic environment, represents a large fraction of the littoral drift.

Although the oceanographic conditions observed during the field experiment are not representative of the long-term LST rate, the acquired data gives valuable insights on the sediment transport processes and reveals the importance of the wind forcing in net LST computations.

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