



## Sand bag barriers for coastal protection along the Emilia Romagna littoral, Northern Adriatic Sea, Italy

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### ABSTRACT

Beach nourishments protected by submerged sand bag barriers have been largely used in Emilia Romagna (Italy), whose low and sandy coast faces the relatively mild Northern Adriatic Sea. The paper, after a brief description of the eight projects of this type realised in the last 25 years along the Emilia Romagna littoral, details the case study of Riccione Southern beach. The performance of the defence is described by means of cross-shore profiles, bathymetries, collection of sediment samples, underwater pictures, monitoring of environmental conditions and performed maintenance. The combined analysis of the available data suggests that the sand bag barrier may stabilise the position of the natural sandy bar and ultimately the beach profile.

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### 1. Introduction

Major threats for large stretches of European coasts are erosion and flooding, which are mainly caused by: loss of river sediment load (due to hydraulic works, bridges, crossbars, dams, on rivers); subsidence (natural or anthropogenic, the latter due to extraction of water, gas, oil, etc.); inappropriate interception of long-shore transport (presence of hard defence, works and harbors along the coasts); dune decay (due to inappropriate management).

Effects of climate change, such as sea level rise and increasing frequency and intensity of storm events, concur in amplifying beach erosion and coastal vulnerability. Due to the low surface elevation and the increasing anthropogenic pressure (from 1950 to 2005, the number of cities included in the coastal zone increased from 318 to 584; the population is forecasted to increase from 70 million-year 2000 to 90 million by 2025; data from [Plan Bleu Report, 2008](#)), the Mediterranean areas will be particularly stricken by climate change.

This picture points out the need of a strategic, sustainable and integrated management of the resource “sediment”. It is noteworthy that the EC project EUROSION ([www.euroSION.org](http://www.euroSION.org)) stressed

both the “shortage of coastal sediments...” and the impropriety of the “current Environmental Impact Assessment (EIA) practices...” in addressing coastal erosion matters.

The coast of the Emilia Romagna Region, in the Adriatic Sea, is an example of coastal zone with a series of erosive problems, accentuated by its long-term strong urbanization. The impact of this site for the Italian economy can be summarised with a few figures related to the tourism activities in the coastal municipalities for year 2006: 41 million of visitors/day in the period May–September, 3384 hotels, 154,000 employees and a gross income/year of 9.8 billion euros.

Indeed due to the strong economical importance of this site the Regional Administration has always been rather interested in coastal environmental issues. For instance, a pilot project was supported in Igea Marina beach consisting in the lowering of the existing traditional detached barriers, in order to improve beach quality despite an expected increase in the yearly sediment loss (Preti et al., 2005). A decadal coastal plan has been recently published (Preti et al., 2009), including two kinds of activities: 1) a series of general initiatives aiming to reduce the causes of erosion, to search new sediment stocks and to arrange an integrated management of these resources; 2) a series of guidelines for local and specific interventions, among which it is coherently suggested to avoid the building of traditional emerged structures in the perspective of more environmental-friendly solutions.

To cope with integrated coastal zone management issues, and particularly with environmental and aesthetic impact of coastal

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