

Sediment research in estuaries and the coastal zone

Luís I. Portela¹

¹LNEC, Av. Brasil 101, 1700-066 Lisboa, Portugal

Phone: +351-218443458

E-mail: lportela@lneec.pt

Abstract: Sediment is the basic material from which estuaries, coastal lagoons and beach and barrier coasts are made. These are among the most dynamic landforms on earth. Human activity has left its mark on coastal systems in many ways and, especially since the industrial revolution, also on the sediment. Sediment management becomes imperative when sediment is too much, too little or too contaminated, and measures have to be taken to address economic, social and environmental concerns.

In a context of weak economic growth and decreasing public resources across much of Europe, to sustainably manage estuarine and coastal sediment, innovative and cost-efficient approaches and solutions are needed. However, there is no innovation without research.

Laboratório Nacional de Engenharia Civil (LNEC) is a Portuguese public R&D institution carrying out activity in civil engineering and related areas. The Hydraulics and Environment Department, with a staff of about 100 (including 35 PhD), performs R&D in all fields of the water domain. It owns large facilities for physical modelling, with a total area of 20000 m², and significant resources for computational fluid dynamics (300 core computer cluster).

Examples of ongoing research include:

- the improvement of numerical morphodynamic modelling systems [1], which can be used to optimize the layout of ports and the management of tidal inlets, thus reducing the costs and adverse impacts of maintenance dredging;
- the development of simple tools to improve the evaluation of the resilience of beach-dune systems to erosion and flooding [2].

Sediment management requires an understanding of local conditions. Estuarine and coastal systems in Portugal vary widely in their characteristics and in the diversity of management issues. For instance, the Douro estuary is a rock-bound, river-dominated estuary, with mainly coarse-grained sediment. Sediment management challenges are primarily related to excessive aggregate extraction and the poorly understood effect of river regulation on sediment supply to the coast [3]. The Tagus estuary, on the other hand, is a major tide-dominated estuary, with extensive intertidal flats. Hot spots of heavily contaminated sediment are an unwanted legacy of former industrial activities [4]. The Formosa lagoon

is a fragile multiple-inlet system, dominated by tide and wave processes. Sediment-related issues include the evolving relation between natural and stabilized inlets and the need to enhance barrier island resilience to storms [5].

Dredging is important to the safety of navigation and to port operation. The mean dredging volume in Portuguese ports is 5×10^6 m³ per annum [6]. Dredging takes place both in inner harbour areas and in outer approach channels, involving cohesive, non-cohesive and mixed sediment. Dredged material is classified into 5 classes of contamination, which condition beach nourishment and disposal at sea (and at estuarine sites). Sea disposal usually takes place below a depth of 40 m. A closer cooperation between port and environmental authorities might be helpful to find science-based solutions that minimize both the present costs and the environmental impacts of dredging operations.

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