



Coastal zone geomorphologic interactions: natural versus human-induced driving factors

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Sediment dynamics in the vicinity of river mouths reveal complex patterns due to the joined effect of river discharges, tides and waves. These phenomena underlie current mathematical and simulation models, which constitute powerful tools that can be used as a complement to monitoring field work for the characterization of morphodynamical patterns in these complex coastal environments.

The Cávado estuary inlet is situated near Esposende and the Douro Estuary about 50 km south of it, next to Porto. During the last years, inland beach migration, sand loss and cliff retreat have been recurrent in this North Portuguese, Atlantic coastal areas, which can be considered to be of the mixed energy and wave-dominated type. Local tides are mesotidal and semidiurnal, with a maximum equinoctial spring tide high-water level of about 3.9 m and 4.0 m and a minimum low-water level of 0.2 m and 0.1 m, for the Esposende and Porto regions, respectively. Mean spring tides are about 3.5 m.

The Cávado estuary inlet, enclosed between a breakwater on the northern side and the end of a migrant sandy spit on the southern side, has been subject to silting up. The spit's resilience is crucial as a natural defense against sea incursions for the town of Esposende which lies behind the spit. During the last twenty years the sea has repeatedly flooded and twice ruptured the spit. To decrease silting-up and increase navigability, the building of two breakwaters and an artificial inlet management has been suggested.

The Douro Estuary inlet is also protected by a northern breakwater and has a protective estuarine barrier sand spit, though in a more inland position than the Cávado spit. This spit protects Douro harbor facilities and the heavily populated river banks against wave and tide actions. Facing similar problems as in the Cávado (silting-up of the navigation channel that runs north of the spit and spit vulnerability to wave and wind action and, particularly to the recurrent river floods) the northern breakwater was extended and an additional breakwater was built (between 2004 and 2008) attached to the spit, to protect it.

The present work discusses and synthesizes results from an integrated approach, involving monitoring field surveys and the application of mathematical models, to describe the main features of these two coastal inlets and adjacent coastal zones, considering the 15 km from the Neiva River to Apúlia for the Cávado river and the 22 km from Crestuma dam to Porto for the Douro river. The influence of river and tidal characteristics are discussed for both cases.