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Genesis and Effects of a Laterally Constrained River Mouth: ~100 yrs of human intervention in the Magdalena River Mouth (South America)

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Abstract

The Magdalena River (Northwestern South America) has one of the highest sediment yields among the major rivers of the world and provides nearly 38% of the total amount of suspended sediment discharged into the Caribbean Sea. The main distributary was intervened in 1936 after the construction of two extensive groynes. Since then, several additional engineering structures have been built along the river mouth. A series of maintaining activities, such as dredging, have been also carried out on a periodic basis. Comparison of ancient cartography, geo-referred aerial photography, satellite imagery, and bathymetric datasets from different periods, allowed to analyze the geomorphological/physical response of the system at different timescales. In addition, the net effect of such human interventions on the hydro-sedimentary regime and nutrient cycling was analyzed through the revision of data on streamflow, suspended sediment, and nutrient load. The influences of man-made structures were beyond the physical reshaping of the adjacent coast, which shifted completely, also included the progressive loss of fragile geomorphic systems as mangrove swamps, coastal lagoons, and barrier islands. The littoral became highly sensitive to morphodynamic factors, not just due to the depletion of sediment supply from the river mouth but also to the disappearance of such geomorphic features. They also disrupted the connection between mainstream and coastal lagoons, distributary channels, and intertidal plains, modifying the residence time within the estuary, and ultimately altering the net ecosystem productivity (NEP). Man-made structures also inhibited the planform morphological response to the changes in the sediment transport regime, leading to severe changes in the patterns and rates of sedimentation. The Magdalena River mouth provides an illustrative example to study physical/estuarine processes in a river mouth system where a low capacity of morphological response to environmental changes interacts with a high-magnitude sediment transport regime.