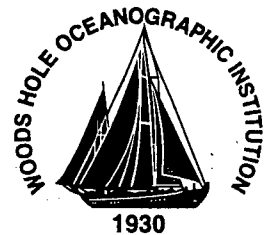


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DOCTORAL DISSERTATION

*Hydrodynamic Controls On Multiple Tidal Inlet
Persistence*

by

Paulo Salles

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HYDRODYNAMIC CONTROLS ON MULTIPLE TIDAL INLET PERSISTENCE

By

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The importance of the persistence of multiple inlets in coastal systems is fundamental for issues such as water quality, navigability, and beach/barrier stability. In long embayments, having extended residence times, the stability of multiple inlets can be important for more efficient flushing and water exchange between the embayment and the ocean.

Many approaches have been used to analyze inlet stability, but have focused on single rather than multiple tidal inlet systems, relying solely on measured data to describe and predict the behavior of tidal inlets and/or suggesting empirical stability relationships between inlet morphology and inlet/bay hydrodynamics. At present, the only multiple tidal inlet stability model available combines a linear analytical model for the flow and an empirical relationship for equilibrium, suggesting that multiple inlet systems are unstable and ultimately all inlets will close or, at best, one will remain open.

Focusing on shallow multiple tidal inlet systems and in particular on Ría Formosa, a shallow coastal lagoon in the south of Portugal known to have maintained persistently multiple inlets in a historical time scale, the morphodynamic and hydrodynamic response to disturbances in the physical characteristics of the lagoon and inlets was studied through a) the analysis of historical data of the region, b) the analysis of tidal data (velocity and water surface elevation) collected in the study site, and c) through the numerical modeling of the system hydrodynamics under various inlet scenarios (using RMA-2V, a vertically averaged finite element model), with emphasis on the contribution of the hydrodynamic response (changes in tidal prism, residual discharge and current, sediment transport capacity, tidal distortion, and cross-sectional averaged maximum velocity) to maintain the multiple inlets open.

The model results show that multiple tidal inlet systems can exhibit stable inlet configurations, and that the strong hydrodynamic interaction between inlets, as well as the non-linear distortion of the tide, play a major role in multiple inlet persistence. Some of the results and findings are specific to Ría Formosa, and others can be generalized and used to identify processes contributing to stability in shallow systems with multiple inlets servicing a single embayment.

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