



On the O'Brien - Jarrett - Marchi law: origins, limits, extensions and long-term tidal morphodynamics

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We verify the applicability of the O'Brien-Jarrett-Marchi law, originally proposed to relate the size of an inlet with the tidal prism flowing through it, to arbitrary sheltered cross sections within a tidal network. We suggest that anywhere the regime of tidal channels may be related to local landscape-forming prisms embedded in a characteristic spring tide oscillation. The importance of the proposed extension is deemed noteworthy, because of its potential for quantitative predictions of the long-term morphological evolution of whole tidal landforms, and thereby of entire lagoons, in response to physical and ecological forcings affecting tidal prisms. This is the case, in particular, for alterations of relative mean sea levels (RMSLs) possibly driven by climate change.

In particular, we show, by collecting evidence from disparate sources, that a relation analogous to those investigated by O'Brien, Jarrett and Marchi holds asymptotically for estuaries and for whole tidal networks. Diverse hydrodynamic tools are employed to evaluate peak flowrates and shear stresses and the ensuing local tidal prisms, and empirical evidence, largely gathered within the lagoon of Venice (Italy), supports our claims. We conclude that the geomorphic law relating tidal prisms and watershed surfaces to cross-sectional sizes anywhere within a tidal landscape is a valuable tool for studies on long-term tidal geomorphology.