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On the applicability of the tidal prism - inlet area relationship to Northern Adriatic Sea lagoons

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The tidal prism-inlet area relationship, well-known as the "O'Brien-Jarrett-Marchi law", relates inlet cross-sectional area to its tidal prism (water volume flowing through the considered inlet during a characteristic tidal cycle), thus embodying the complex relation between the channel morphological characteristics and the related hydrodynamic features.
Our work is mainly focused on the correct application of this relationship to the lagoons of the Northern Adriatic Sea, in order to analyse the applicability of the above recalled law to lagoons characterized by a dynamic behaviour, with non-negligible effects of tidal propagation. In particular, we integrate the dataset collected by Jarrett (1976) with the data concerning the Venice lagoon and the Delta Po lagoons.
First, we investigate the modifications in tidal prism and inlet area induced by the most invasive anthropic interventions carried out within Venice lagoon during the last two centuries. To this purpose, we use a fully-coupled 2D finite element hydrodynamic model to analyse the hydrodynamic behaviour of five morphological configurations representative of the lagoon morphological evolution from 1811 to 2003. The analysis shows that the lagoons characterized by a quasi-static hydrodynamic behaviour, such as Delta Po lagoons and the more recent morphological configurations of Venice lagoon, are better described by the O'Brien-Jarrett-Marchi relationship when compared to the past morphological configurations of Venice lagoon, which are characterized by a dynamic behaviour.
Finally, we compare the results obtained by analysing natural lagoons with those obtained by considering data collected within laboratory physical models, and critically discuss them on the basis of theoretical interpretations of the tidal prism-inlet area relationship recently proposed by several authors. This application highlights the need to compare data on the basis of a "modified tidal prism" which takes into account the "scale effects" characterizing physical models.