Diversity in tidal network morphology: exploring the potential role of the marsh geomorphic setting

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Tidal networks consist of a complex systems of branching, usually blind-ended tidal channels and creeks that show a great spatial diversity in geometrical and topological forms, with implications for the marsh biogeochemical cycling and vegetation productivity. Despite a number of studies have revealed the role of several controlling variables, there is currently a lack of clear theories to explain such diversity. In this contribution, we intend to bring further insights into this research topic by investigating the role of the marsh geomorphic setting on tidal network morphology and drainage efficiency.

Numerical simulations are performed using a two-dimensional modelling framework that explicitly simulates the co-evolution of the marsh platform with the embedded tidal networks on the basis of the ecomorphodynamic approach, i.e., the modelling framework considers interactions and feedbacks between the hydrodynamics and the morphology, driven by sediment transport and mediated by vegetation growth through related ecogeomorphic processes.

Model scenarios consist of simulating long-term marsh evolution starting from three initial schematised domain geometries representative of open coast, island and back-barrier marsh geomorphic settings, using same dimensions. To isolate the role of the geomorphic setting, all scenarios are forced with similar tidal water levels and suspended sediment concentrations; other physical parameters are kept identical correspondingly.

Measures of channel and network size and shape such as network length, area, outlet width, tributary count, Strahler stream order, channel sinuosity, drainage area, density, and efficiency are computed for the simulated tidal networks for every model scenario and compared against those of natural tidal networks. Pronounced differences in these properties allow to differentiate between network morphologies as a function of the underlying marsh geomorphic setting. Moreover, results may further help restoration practitioners in the selection and design of effective tidal network designs for a given tidal marsh restoration scheme.