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Morphodynamic evolution and stratal architecture of tidal meander bends through geophysical investigations and numerical modelling: inferences from the Venice Lagoon (Italy)

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Although meanders are ubiquitous features of the tidal landscape, very few papers have analyzed their morphodynamic evolution or internal architecture, which is commonly analyzed basing on facies models developed for fluvial meander bend deposits.
Towards the goal of providing new insight into the morphodynamic evolution of tidal meanders, together with high-resolution facies models, we analyzed a tidal point bar located in the Northern part of the Venice Lagoon (Italy), the largest Mediterranean brackish water body, characterized by an area of about 550 km2 and subjected to a semidiurnal tidal regime with an average tidal range of about 1 m and peak tidal amplitudes of about 0.75 m.
High-resolution spatial data were acquired through the use of a sub-bottom profiler along a meander bend in the Northern part of the Venice lagoon. Sub-bottom profiles were collected along transects oriented both parallel and transverse to the main channel axis, and interpreted through a specific 3D modeling software. In the study segment, the channel is 100 m wide and 3 – 5 m deep and defines a bend with a curvature radius of about 200 m.
Geophysical data highlight the presence of two laterally extensive key surfaces, which divide the channel deposits into three sedimentary units (up to 6.0, 4.0 and 3.5 m thick, respectively), associated with three main depositional stages of meander bend evolution. All these stages emphasize the occurrence of an ebb - dominated transport, especially in the first and in the second ones.
The first stage is associated with development of point-bar deposits and is characterized by lateral accreting beds dipping toward the channel thalweg at about 10-20°. The second stage is associated with deposition in the landward side of the meander bend, where both aggradation and lateral accretion are documented. The third stage is characterized by accumulation of deposits at the outlet of two minor tributaries entering along the outer bank of the channel.
A mathematical model for sediment entrainment, transport and deposition promoted by the combined action of tidal currents and wind waves in shallow micro-tidal systems has been used to analyze the morphodynamic evolution of the meander bend highlighting the role of the interaction between the flow field in the main channel and that occurring within minor tributaries in determining local accumulation or erosion. Further geophysical, sedimentological and chronological studies are needed, but our preliminary results suggest that tidal channels, and related point bars, cannot be analyzed based on similarities with their fluvial counterparts.