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On the morphodynamic evolution of tidal environments

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We address a comprehensive theoretical framework suitable for large-scale, long-term modelling of the eco-morphodynamic evolution of tidal environments. To this end a mathematical model of channel network development is coupled with relevant eco-morphodynamical processes governing the landscape evolution of tidal systems. Such processes are: inorganic and organic soil production; sediment transport; vegetation dynamics and relative sea-level regressions and transgressions. The model of network ontogeny describes tidal network initiation and its progressive headward extension through the carving of incised cross-sections where the local shear stress exceeds a predefined, possibly site-dependent threshold value and retains the description of the main physical processes responsible for tidal network development. The coupled model allows one to investigate the influence on channel network dynamics of the vertical accretion or decretion of the tidal-flat and salt-marshes surface, resulting from the balance between erosion and deposition processes, of the vegetation distribution, as well as of marine transgressions and regressions. The overall model makes it possible to reproduce sedimentation patterns typical of tidal environments and to analyze the response of tidal morphologies to different scenarios of changing sea-level, incoming sediment concentrations and colonization of halophytic vegetation.