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CarbTMM - Coastal carbon release driven by tidal meander migration

Coastal carbon release is drawing escalating concern globally, primarily because of its adverse effects on climate change mitigation and the pursuit of carbon neutrality. Driven by outer bank collapses, tidal meanders frequently migrate across coastal landscapes, revealing sediment layers that would otherwise remain concealed. This exposed sediment is rich in organic carbon, which is released back to the atmosphere upon oxidation. Despite the significance of this mechanism, a notable research gap exists in linking coastal carbon release to the intricate dynamics of tidal meander migration (TMM). This void can be attributed largely to the challenges of accurately simulating TMM. To bridge this research gap, CarbTMM aims to unravel the mechanisms underlying TMM and to understand its influence on coastal carbon release. The proposal will address four pivotal objectives. Firstly, investigate the mechanisms of bank collapse in tidal environments through physical experiments, and formulate parameterized, physics-based functions that accurately capture characteristics of such collapse events. Secondly, refine the start-of-the-art morphodynamic models by integrating newly developed functions for bank collapse, to better simulate the evolution of single tidal meanders (Nays2D) and complex tidal networks (Delft3D). Thirdly, formulate an idealized, process-based TMM model for global-scale applications, drawing on insights from the refined sophisticated models. Lastly, generate and evaluate projections detailing TMM-driven coastal carbon release at global scale under current and future climatic scenarios (e.g., sea-level rise). In achieving these objectives, CarbTMM aims to provide profound insights into the coastal carbon cycle and strengthen our proficiency in assessing potential capacity of coastal carbon storage. Furthermore, predicting TMM near coastal infrastructures can help protect coastal communities and their assets.

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