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The development and application of landscape evolution models to coupled coast-estuarine environments

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Landscape Evolution Models (LEMs) are proven to be useful tools in understanding the morphodynamics of coast and estuarine systems. However, perhaps owing to the lack of research in this area, current models are not capable of simulating the dynamic interactions between these systems and their co-evolution at the meso-scale.

Through a novel coupling of numerical models, this research is designed to explore coupled coastal-estuarine interactions, controls on system behaviour and the influence that environmental change could have. This will contribute to the understanding of the morphodynamics of these systems and how they may behave and evolve over the next century in response to climate changes, with the aim of informing management practices. This goal is being achieved through the modification and coupling of the one-line Coastline Evolution Model (CEM) with the hydrodynamic LEM CAESAR-Lisflood (C-L).

The major issues faced with coupling these programs are their differing complexities and the limited graphical visualisations produced by the CEM that hinder the dissemination of results. The work towards overcoming these issues and reported here, include a new version of the CEM that incorporates a range of more complex geomorphological processes and boasts a graphical user interface that guides users through model set-up and projects a live output during model runs. The improved version is a stand-alone tool that can be used for further research projects and for teaching purposes. A sensitivity analysis using the Morris method has been completed to identify which key variables, including wave climate, erosion and weathering values, dominate the control of model behaviour.

The model is being applied and tested using the evolution of the Holderness Coast, Humber Estuary and Spurn Point on the east coast of England (UK), which possess diverse geomorphologies and complex, co-evolving sediment pathways. Simulations using the modified CEM are currently being completed to ascertain the processes influential to the morphodynamics and evolution of these systems; presently this includes increasing sea levels and changing wave climate patterns. Outputs and findings from these runs will be presented and discussed, with the aid of the improved graphical visualisations and animations that illustrate the evolution of simulated environments.