CoastalME: Coastal Modelling Environment

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SUMMARY

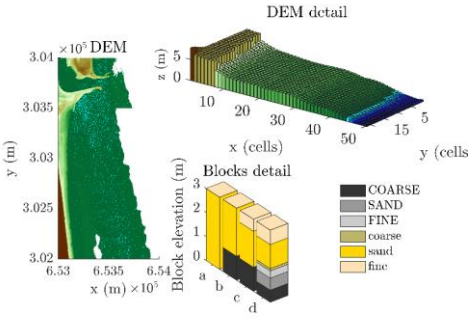
- CoastalME is a generic modelling environment to simulate coastal landscape morphodynamic
- Application at spatial scales of kms to tens of kms, over decadal to centennial timescales
- Coastal change is driven by gradients in alongshore sediment transport and local sediment sink/sources
- Coastal change is modulated by variable external forcing and stratigraphy
- Include consolidated and unconsolidated sediment types and three sediment fractions (coarse, sand, fine)
- Complex 3D topographies are represented as raster Digital Elevation Model (i.e. outputs are GIS layers)

CoastalME simulates coastal morphology evolution as a set of dynamically linked raster and geometrical objects that evolve through time driven by variant or stationary boundary conditions and following certain user defined morphodynamic principles. Gradients in wave-driven alongshore transport related to coastline shape provide a cornerstone principle for combining different landform specific models.

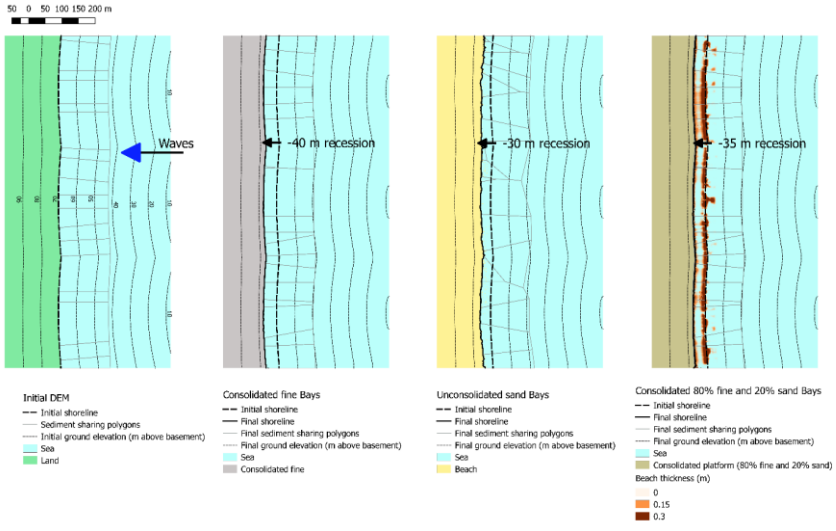
ASSUMPTIONS

- Existing simulation models (i.e. SCAPE, COVE, ASMITA) can be integrated within a bespoke geometric modelling framework if designed carefully.
- Coastal geomorphology can be represented as regular square blocks (Fig. 1). Blocks can increase or decrease thickness and are made of consolidated and non consolidated material and each layer contains a given amount of fine, sand and coarse sediment.
- A set of geometrical objects (lines, areas and volumes) provide a reduced number of interactive elements (e.g. shoreline, beach profiles and suspended sediment volume) at the appropriate spatial scale of analysis: larger scale than individual's raster cells but focused only on those cells that are active every time step.

Fig. 1: Coastal geomorphology represented as square blocks



CoastalME as COVE, uses a local coordinate scheme (rather than global), and divide the coastline as a set of sediment sharing polygonal shapes (e.g. triangles and trapezoids). Unlike in COVE, in CoastalME there is no prior requirement of beach slope being equal to the shore platform slope. By relaxing this assumption of beach and shore platform slopes being equal, CoastalME can resolve a larger number of combinations of beach and shore platform geometries.



Cliff and shore platform are made of consolidtaed sediment. Eroded consolidated sediment is transferred to the different unconslolidated sediment fractions or suspended sediment volume (Fig 2). The **conservation equation** for unconsolidated sediment states that the change in volume of sediment sharing polygons along the coastline, through time is a function of the divergence of alongshore sediment flux.

Sediment flux is driven by breaking waves. Propagation of offshore can be transformed using simple geometries or the DEM to estimate the wave properties at breaking.

Fig. 2: Example landscape evolution of the same initial DEM, driven by the same external forcing but different sediment fractions

DATA

- The model requires an offshore (~unaffected by refraction, shoaling and shadowing) wave data and the Still Water Level at the beginning and the end of the simulated period.
- A basement file used as reference for block elevation, a minimum of one layer of consolidated sediment and one layer of non consolidated sediment.

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