Forecasting the biogeomorphic development of intertidal wetland restoration: a novel modelling approach

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Managed realignments - i.e. the landward displacement of seawalls in order to create new intertidal habitats on formerly embanked land - are becoming an important engineering option enabling the reduction of the costs of coastal defenses, providing a sustainable approach in dealing with sea level rise and simultaneously delivering environmental benefits through the creation of intertidal habitats. A major challenge in managing, planning and executing managed realignments lies in optimizing their design in respect to abiotic factors (e.g. dimensions of dike breaches or of channel networks) and biotic factors (e.g. revegetation or natural establishment of plants) in order to guarantee success within the desired time frame. Due to the novelty of this approach and the lack of long-term data available, numerical models are applied to breach this gap.

We use a coupled finite element hydrodynamic- (TELEMAC2D), morphodynamic- (SISYPHE) and an in-house developed vegetation growth model, in combination with field experiments and measurements, to forecast the development of a future managed realignment site over a period of several decades (465 ha, Hedwige-Prosperpolder, Scheldt estuary, Belgium & The Netherlands).

The novelty of our approach resides in the subgrid/mesh approach which is used in modelling spatio-temporal vegetation development. This approach allows us to take small scale (e.g. 0.25m) interactions between vegetation, flow and sediment transport into account although the hydro-geomorphic model is run on a coarser gird (e.g. 5m). It not only reduces computational time, opens possibilities for sensitivity testing, but potentially conserves the importance of small scale vegetation dynamics on shaping landscape patterns such as the erosion of channels.

This study summarizes the vegetation and sedimentation parameterization, and discusses preliminary results in the context of large-scale (100s of ha) biogeomorphologic development for long-term (decades) forecasting and its management implications.