DEL117 - Developing Delft3D-GeoTool to predict coastal evolution under sea-level rise

The Delft3D-GeoTool is an online, cloud-based tool to model sediment transport, deposition and reworking in prograding deltas.

It generates, stores and classifies 3D sediment volumes in these simulated delta environments, where rivers, tides, waves and sea level rise can play a role.

Why model sediment deposits in deltas?

Deltas worldwide face a number of threats. They are typically low lying areas which are sensitive relative sea level rise which can lead to increased flooding risk or even permanent flooding. In natural systems, as relative sea level rises, sediment is deposited in these areas such that the land elevation can increase at the same rate as the increase in relative sea level. However, a problem occurs when the relative water level rises at a faster rate than what sediment can be redirected to the low lying areas, or when low lying areas have been engineered such that they are not sufficiently protected from increases in relative sea level rise. Therefore, understanding the natural sediment dynamics in these complex hydrodynamic systems are important to understanding how deltas will be able to cope with increase in relative sea level.

In addition, the sediment layers in the subsurface act as a natural storage for fresh water. Understanding the configuration of these subsurface layers, and being able to represent them digitally as part of a 3D geological model, helps to constrain predictions of changes in fresh water availability with increases in relative sea level or other climate change related pressures.

How does this project contribute to the larger goals?

D3D-GeoTool can be used to study changes in sediment distributions at the surface (bathymetry) and below surface (stratigraphy) in shallow marine /coastal systems.

A better understanding of the way in which delta sediment distribution changes with rising relative sea level can help coastal managers to plan for the future. Such sediment dynamics can already be modelled in the Delft3D-GeoTool, but in this project we would like to make these results accessible to a larger community (Output 1). Furthermore, in this project we also work on improving the representation of processes which play an important role in determining sediment deposition and redistribution during relative sea level rise (Output 2). lastly, we post process the simulation results in a new way, to make it more compatible with geological modelling in techniques. We use this new post-process data in a proof-of-concept case study for ground water modelling (Output 3).

Output

In this project we worked on:

1. Making Delft3D-GeoTool more accessible to a wider community
2. Techniques for simulating century-scale sediment erosion, transport and deposition for a coastal setting under a rising sea level.
    - Approximating along shore transport on long timescales
    - Modelling relative sea level rise by through sediment compaction
3. Tools for applying Delft3D-GT output to improve statistical geological modelling workflows for various uses, such as fresh water availability.
    - A case study to entice new users, growing the user community

The Past ← Delft3D-Geotool → The Future