

# Erosion of the Lower Sea Scheldt explained

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## 1. Introduction

The Lower Sea Scheldt upstream of Antwerp is part of the Scheldt estuary. In the past 5 decades significant erosion up to 7m has occurred in this part of the Lower Sea Scheldt. In the same period the tidal range has increased significantly. No maintenance dredging takes place in this part of the Lower Sea Scheldt, however in this research the hypothesis is investigated that human activities downstream of Antwerp are the cause of this erosion.

## 2. Methodology

The 2D process-based morphodynamic model FINEL2d is used to investigate the hypothesis. The model first needs to be set-up and calibrated. The model includes part of the North Sea, the Western Scheldt and the tidal rivers in Belgium and is driven by tidal boundary conditions. For the calibration the observed erosion from 1960 – 2010 is hindcasted. The model is calibrated on (observed changes in) tidal waterlevels, morphodynamic changes, and dredging volumes (The model has a dredging module).

Figure 1 shows the modelled and the observed erosion pattern for the 1960-2010 period. The model has a Brier-Skill Score of 0.58 for the morphological developments, which means that the model scores very well to calculate the observed erosion. Erosion volumes are predicted very well by the model as well as dredging volumes in the downstream part of Antwerp. The increase in tidal range of several dm over this 50 years is predicted well by the model.

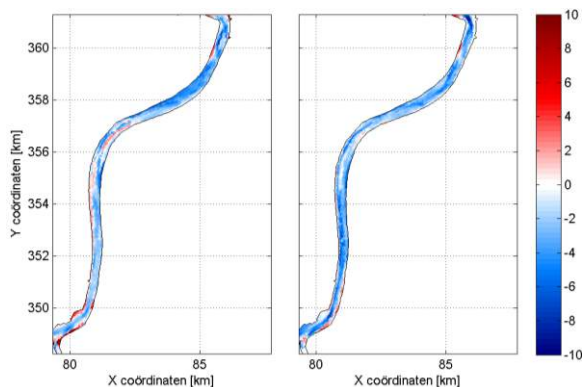


Figure 1: Erosion from 1960- 2010 in meters. Left: FINEL2d model; Right: observed erosion.

## 3. Scenarios.

Using the calibrated morphological model 3 extra scenarios have been defined, see Table 1. The T0 scenario is the calibrated run of the model in which human impacts have been carried out like reality. The T1 run is without any human activity, The T2 scenario is an extreme sand mining scenario, in which maintenance dredging is not dumped back into the system. Finally in the T3 scenario no deepening of the navigational channel have been carried out (in reality in the '70's , the '90's and recently in 2011).

Scenario	Description
T0	Current situation, human impacts as reality
T1	As T0, but without any human impact
T2	As T0, but no dumping of maintenance dredging
T3	As T0, no deepenings; maintain 1960's depth

Table 1: Scenario definition

The scenarios show that human activities are clearly responsible for the increased tidal range in the Lower Sea Scheldt: the more human activities (dredging, deepening and sand mining) the more the tidal range increases. The net sand transport at Antwerp is also clearly affected by human activities: the more human activities downstream of Antwerp, the more net sand transport is directed downstream. This 'pulling' of the sand transport however is also felt upstream of the area of interest, so that the gradient of the sand transport (which causes the erosion) remains more or less the same. This makes that for all scenarios more or less the same erosion in the Lower Sea Scheldt (upstream of Antwerp) occurs, even for the scenario without any human activities. The erosion therefore cannot be contributed to human activities, but is a natural phenomenon of the system itself.